

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Journal

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A Letter to Readers

I am extremely grateful to the dedicated men and women of our agency for their professional contribution to the safety of California's motorists. The departments within the Business, Transportation and Housing Agency comprise the Governor's principal transportation regulatory and enforcement organizations. By combining their resources, we are making driving safer, as evidenced by the fact that the number of fatalities per miles traveled is now the lowest in the state's history.

As Secretary for Transportation, I am committed to having the best traffic safety programs possible, including anti-DUI, bicycle and pedestrian safety, occupant protection, police traffic services, roadway safety and emergency medical services. These programs and so many others are helping California achieve its traffic safety successes, such as having the highest seat belt compliance rate in the nation.



Maria
Contreras-Sweet

I have a charge from Governor Gray Davis to improve safety on California's roadways. That means relieving traffic congestion, thus affording people more quality time for work and family life. We all enjoy getting home quickly and safely after a hard day's work.

One of our shared goals is to alleviate traffic congestion by stopping unsafe driving behaviors that contribute to accidents. Through funding for more law enforcement personnel and equipment, emergency response vehicles and public education, we will make our roads even safer. We are also excited about the new partnerships being established with community-based organizations in California. This innovation will expand our outreach enormously. The Governor recently awarded \$11.8 million to local community-based organizations to promote traffic safety programs.

Traffic safety is everyone's business. Governor Davis and I look forward to working with all of you to improve the quality of life for all Californians.

A stylized, handwritten signature in white ink that reads "Maria Contreras-Sweet".

Maria Contreras-Sweet

CALIFORNIA DEPARTMENT OF TRANSPORTATION

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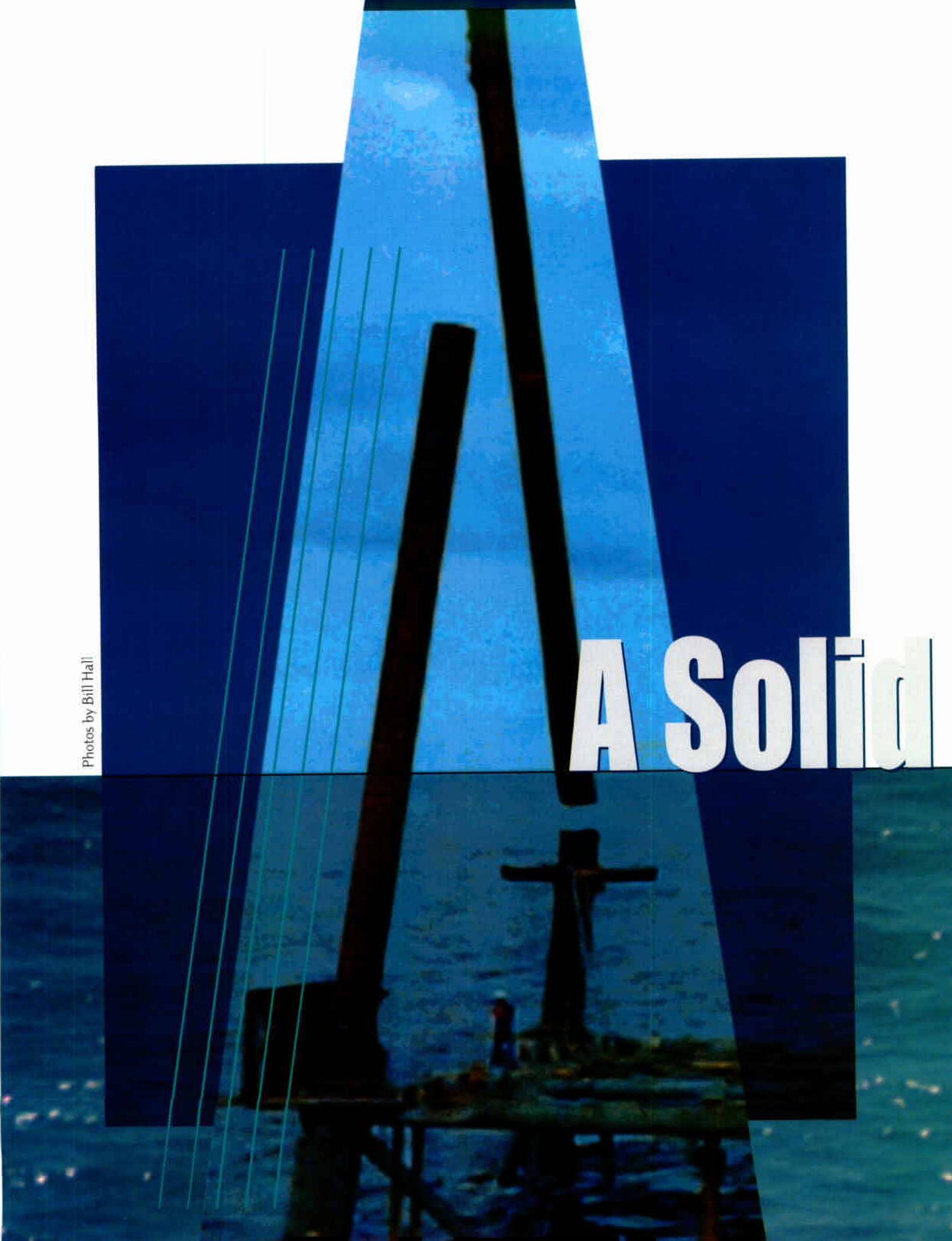
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Journal Editor finds Buddha



Photos by Bill Hall

A Solid



Dr. Brian Maroney stands in his cluttered office at Sacramento's Farmer's Market #1, feet together. His body waves like a reed in the wind. "This is what happens with vertical piles under certain conditions in an earthquake," he says. Maroney spreads his feet apart. "Now, look what happens. I have a great deal more structural rigidity."

Maroney is demonstrating the difference between vertical piles and the "battered," or inclined, piles being tested in a \$7.3 million demonstration project for piles to be used in the replacement of the eastern span of the San Francisco-Oakland Bay Bridge. "It's about setting up conditions to make less material do more for you as an engineer," says Maroney, a Supervising Structural Engineer.


Maroney heads a team that is developing the seismic treatment for the bridge replacement, which, at an

estimated cost of \$1.5 billion, is likely to be the most costly project ever undertaken by Caltrans.

"The concept came up when we were still anticipating a retrofit of the existing east span," Maroney says. "We were working with Chris Traina (a Caltrans Bridge Cost Estimating Engineer) on ways to limit the permanent displacements of the caissons that were part of the retrofit project.

"We were offering different ways to reduce the displacements and Chris would offer guidance as to how expensive each strategy would likely be.

This is a good example of how work on the retrofit of the east spans allowed us to choose new bridge structure types



Foundation for the East Span

**Deep Sea
Technology
Goes to Work
for the Bay
Bridge**

wisely, which enhanced the performance. When it became clear a replacement strategy for the east spans was a better financial and engineering alternative, we asked the design team to evaluate the use of battered piles to improve the design of the replacement, and they did a good job.”

Offshore oil drilling companies had used battered piles successfully for two decades, but they were used only occasionally and under special conditions for bridges. “Battered piles had a reputation for performing poorly in seismic events,” says Maroney. “But when the project team analyzed those failures, what we saw was that they hadn’t been designed for seismic events. If we could prepare a design that took all the factors into account, battered piles might have advantages, especially in the muds that underlie the San Francisco Bay.”

The project team has been meticulous in its study of the materials in which they will have to work, doing \$15 million of geotechnical study while developing the seismic strategy for the bridge. This preliminary work is expected to pay off in a clear knowledge of the properties of the materials into which the piles will be embedded. “The Lower Alameda Formation, a mixture of sand and clay, not strictly classified as rock, is about as close to rock as you can get,” Maroney says.

Earthquake ground motions near the San Francisco Bay typically strike with great intensity because the layers of soft mud amplify the motions of the seismic event to any structures on them. Studies of earthquakes in other settings had driven an observation that stiffer structures would perform better in a severe earthquake in such an environment. Ancient stone churches of a very rigid construction, for

instance, survived the 1985 Mexico City earthquake, when more modern but less rigid structures did not perform as well.

“This is an instance of wisely avoiding resonance,” says Maroney. Seismic resonance is the condition of earthquake motions being of very similar frequency to a structure’s natural frequency, which causes the structure’s response to grow exponentially.

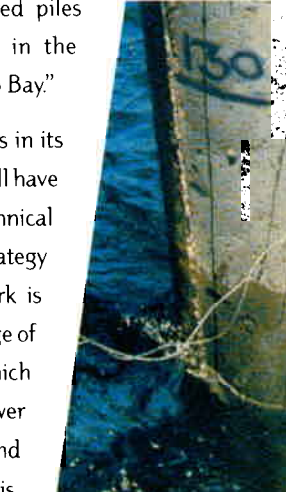
Battered piles could provide a number of advantages. The retrofit project had offered evidence that vertical pile groups were costly and not efficient because of a phenomenon called pile shadowing.

If piles are too closely spaced, the soil between them is overloaded and becomes less effective. This can set up a condition in which two piles must be placed in the ground to provide the strength and stiffness of one.

If the spacing of the vertical piles is simply increased, the pile group efficiency will increase. But such a design requires a larger and more costly pilecap that would generate larger seismic loads, because its larger mass negates some of the effectiveness of the pile group. The battered pile foundations benefit twice. By being anchored in stronger materials below the bay muds at a depth at which the presence of the batter has spread the pile group, the shadowing effect is eliminated.

The battered pile foundations also benefit from the deeper point of effective fixity, since seismic motions tend to increase as the waves propagate to the surface from the bedrock below.

The battered piles looked good on paper, but their benefits came at a price. The design of the smaller pilecap becomes more complicated. The design team must design for three shears and three moments, which are generated from the enhanced frame action of the battered piles and the pilecap, at the pile-to-pilecap connection.



Earthquakes
near the San Francisco Bay typically strike with great intensity because the layers of mud underlying the bay amplify the force of the seismic event to any structures standing on top of them.

Maroney says, "This is quite achievable and well worth the benefits realized along the length of the new spans. We have an outstanding geology and design team that is up to the task and we know how to do it."

The final hurdle in realizing the success of the battered piles is to work with Caltrans' construction partners to demonstrate that this type of construction, which is new to us, can be completed without unknown and unnecessary complications," says Maroney. Hence, the demonstration project. The demonstration consists of driving three piles at two sites near the existing East Span. The sites are in open water and fall within the Caltrans 150m maintenance area extending north and south from the centerline of the existing bridge. Caltrans identified the test sites based on their location within the east span project area, soil conditions, and on additional criteria including adequate water depth and minimal potential conflict with other marine vessels or future bridge construction operations.

The demonstration project presents mammoth problems. The 2.5 m (7 1/2 ft.) diameter steel piles, of the type proposed for the main span and skyway, must be long enough – 100 m – to extend through the soft bay muds into the dense marine sands of the Alameda Formation. Stand a football field on end and you've got an idea of their length.

Essentially hollow steel tubes, the piles will be driven into the rigid materials below the bay. The actual bridge piles will be filled with reinforced concrete to provide additional structural rigidity and strength for the bridge foundation.

The test will be conducted from a floating platform similar to those used by oil companies to drive piles for deep sea drill rigs. The contractor will have to devise a template to keep the massive pile within 200 mm of the precise 6:1 incline, then control its "run" as it drives through the top layers of soft mud. That run could be as long as 30 m, and the first application of the 1700 Kj hammer could send it another 10 m into the mud.



"It is one thing for us to be confident of the technology but, in order for our contractors to bid prudently, they have to be confident of it, too, says Maroney. "So we do a demonstration project and let the contractors watch." The pile installation demonstration project will provide Caltrans and its contractors with critical information to plan and finalize construction techniques.

The piles will be monitored throughout the driving process to determine the amount of run and the resistance encountered with each application of the hammer. Samples of the materials encountered will be tested to assure that they are consistent with results already developed through earlier geotechnical testing.

"When you drive a pile into the soil, you are failing the soil," Maroney says. "With the Lower Alameda Foundation, our tests show that the material will be initially strong enough to support the bridge structure, but it will regain its strength over time. Over a period of about a year, it will become very strong and we will have more than adequate rigidity and strength for the new bridge."

The demonstration will also help determine whether or not to place the piles as a single unit, or place them in two or more pieces and weld them together. If they are placed in pieces, the demonstration will provide information about the quality of the welds – an essential in producing the quality steel pile foundation needed.


Mansion and Dutra, a Bay Area joint venture, both with extensive experience in building structures in marine environments, was awarded the \$7.3 million contract to perform the demonstration project on July 14, 2000. The joint venture will fabricate a 25 m-tall (80 ft.), template to hold the piles in place, incorporate a 1700 Kj hammer, and place it on eight temporary piles to be driven into the Bay mud at two separate sites. The piles will be placed in three or four sections and welded in place.

The contractor will have a 48-hour window in which to weld the pile sections together, reposition the template and hammer and complete ultrasound testing of the welds. If they are allowed to rest for longer than 48 hours it is likely there will be difficulties in resuming the driving. Testing of the welds will be done by ultrasound, bouncing sound waves through the welds to find any imperfections.

Caltrans' Construction Engineer for the demonstration is Mark Woods, a Range D with eight years experience in the Caltrans Structures division on a variety of projects. Aided by a staff of four assistants and plenty of help from various engineering divisions throughout Caltrans, he will oversee the 35-day project.

After placement, the piles and surrounding materials will be monitored for at least a year. They may be used during construction of the replacement bridge, then cut off at the mud line, having done their job.

"We are demonstrating to our partners that these piles can be placed efficiently," Maroney says. "We believe this demonstration project will forestall unnecessary increases in contractors' bids to account for unknowns concerning the battered piles. We intend to remove those unknowns in order to get lower bids from our contractors."



The demonstration project presents mammoth problems. The 40 to 70 mm thick, 2.5 m-diameter steel piles, of the type proposed for the main span and skyway, must be long enough – 100 m – to extend through the soft bay muds into the dense marine sands of the Alameda Formation.

A Major Team Effort

If, someday, someone were to give an awards banquet similar to the Academy Awards, and they gave an award to the team that developed the battered pile concept for the San Francisco-Oakland Bay Bridge replacement project, half the audience would be trooping to the stage to accept.

Unique and difficult projects don't get done by a single person. The Pile Demonstration Project has been supported by a large team of geologists, engineers and environmental planners from inside and outside Caltrans.

Senior Transportation Engineer Pochana Chongchaikit, (shown inside pile, inset)

District Project Engineer Sharon Naramore and Toll Bridge Construction Engineer Mark Woods have provided leadership to the team.

The concept started with the cost analysis of retrofitting the existing bridge. Chris Traina, at that time a Senior Bridge Engineer in the Structures Cost Estimating Section, worked with bridge designers Eric Zechlin and Eric Moran on the earliest concepts of using battered piles. Before the concept was advanced to project status, Caltrans design engineers reviewed the concept for constructability with Gerwick, the 80-year-old former president of Ben C. Gerwick Construction and a professor at U. C. Berkeley.

The team also included:

John Thorne, and Reed Buell, Caltrans geologists

Ronnie Gu, Bob Price and Saba Mohan, Caltrans geotechnical engineers

Tony Dover, Bob Stevens and Po Lam from the Fugro - Earth Mechanics joint venture

Jeff Aldridge, CH2Mhill specifications engineer as a subconsultant to Parsons Brinkerhoff, Jerry Houlihan, T. Y. Lin - Moffitt and Nichols

joint venture structure designer

Paul Bahga, Caltrans structure designer,

Marilee Mortonson, Caltrans environmental planner

Joy Mashaal, Woodward - Clyde - URS Griener Consultants wildlife biologist

Nick Fioentinos, Caltrans Right of Way agent

"These people and many others have worked so hard that sometimes I'm ashamed to be asking so much of them," says Brian Moroney. "They are saving the taxpayers a tremendous amount of money and they're going to give them an outstanding bridge."





Putting the Plan to Work

California's transportation agencies have responded quickly to Governor Gray Davis' call to funnel additional funds into traffic congestion relief. Caltrans presented 31 projects totaling almost \$400 million to the California Transportation Commission at its meeting on September 26 and 27. The Commission allocated \$187.8 million to the projects for this year with funding for the rest of the \$400 million to come as the projects continue to develop.

The new funds will be applied against projects that total almost \$2.5 billion, underlining the governor's objective of using the State funds to stimulate spending from other sources.

The projects range in size from a \$350,000 study of the Metropolitan Bakersfield Transportation System to a \$71 million improvement to the Carmenita Road Interchange on Route 5 in Norwalk. They involve numerous local and regional agencies in addition to Caltrans.

Governor Davis' Congestion Relief Plan, among other measures, provides about \$2 billion in first-time-ever funding from the General Fund, and another \$3 billion through redirection of the State sales tax on gasoline. These new funds are piled atop the \$12 billion in the State Transportation Improvement Program and the State Highway Operation and Protection Program already earmarked for transportation over the next six years.

Overall, the plan puts new emphasis on three main transportation challenges: easing congestion in some of California's most heavily traveled transportation corridors, improving the movement of commerce and addressing the frustration travelers face with transportation modes that do not interconnect.

The projects include the following, listed by amount and the requesting agency:

\$3.2 million Metropolitan Transportation

Commission – Study of a new crossing of the San Francisco Bay in Alameda and San Francisco or San Mateo counties and implement the Transbay Terminal Improvement Plan

\$15 million Caltrans – Initiate Environmental studies of a fourth tunnel bore for the Caldecott Tunnel on Route 24 in Alameda County

\$7 million San Francisco Municipal Railway – Reconstruct the San Francisco Muni Light Rail Line on Ocean Avenue in the City and County of San Francisco

\$1 million Solano Transportation Authority – Major Investment Study for Interstate 80 in Solano County with focus on I-80/680 Interchange

\$100,000 North Coast Rail Authority – Environmental remediation projects for the North Coast Railroad

\$10 million North Coast Rail Authority – Provide \$10 million in debt reduction to the North Coast Railroad

\$50,000 North Coast Rail Authority – Match local funds for projects on the North Coast Railroad

\$5.5 million North Coast Rail Authority – Provide fund repayment of federal loan obligations for the North Coast Railroad

\$40 million L.A. Blue Line – Extend the Blue Line rail line between Los Angeles and Pasadena

\$15 million Caltrans – Add a northbound HOV lane over the Sepulveda Pass on Route 405 between Route 10 and Route 101 in Los Angeles County

\$290,000 Caltrans – Phase 2 of a project to improve the Carmenita Road Interchange on Route 5 in Norwalk in Los Angeles County

\$2 million Caltrans – Complete a corridor study to improve Route 710 between the ports of Los Angeles and Long Beach and Interstate 5 in Los Angeles County

\$3 million Caltrans – Improve Route 101 between Route 110 and Route 23 in Thousand Oaks in Los Angeles and Ventura Counties

\$1.5 million Caltrans – Initiate a project to complete three miles of a six-lane freeway on State Route 71 through Pomona from Route 10 to Route 60 in Los Angeles County

\$4 million Caltrans – Improve the Route 101/405 interchange in Sherman Oaks in Los Angeles County

\$1.7 million City of Los Angeles – Improve automated signals at various street locations in the city of Los Angeles

\$3 million SCRRA – Track and signal improvements on Metrolink in San Bernardino County

\$3.9 million Caltrans – Reconstruct the Apache Trail Interchange on Route 10 in Riverside County

\$1.6 million North County Transit District – Acquire one new train set to expand commuter rail in San Diego County

\$1.7 million Caltrans – Build new freeway connector ramps at the Route 94/125 interchange in Lemon Grove in San Diego County

\$2 million CSU Fresno – Develop preliminary plans, working drawings and related program management for CSU Fresno Events Center.

\$4 million Sacramento Regional Transit – Extend the Sacramento South Line light rail from Meadowview Road to Calvine Road in Sacramento County

\$20 million Sacramento Regional Transit – Extend Sacramento Light Rail System Folsom Line to Downtown Folsom and from 7th/8th Streets in Sacramento to the AMTRAK Station

\$16.5 million Sacramento Area Council of Governments – Incentive for reduction of emissions from heavy-duty diesel engines in Sacramento County

\$16.6 million SACOG/Yolo Transportation District – Provide approximately 50 replacement low-emission buses for Sacramento and provide Yolo bus service

\$350,000 Kern Council of Government Metropolitan Bakersfield System – Study to reduce traffic congestion in the metropolitan Bakersfield area

\$3 million County of Sacramento – Interchange modifications to the Route 50/Sunrise Boulevard Interchange in Sacramento County

\$2.3 million Bay Area Rapid Transit District – Expansion of the Balboa Park BART Station in the city of San Francisco

\$2 million City of West Hollywood – Repair, maintain and provide mitigation to upgrade Santa Monica Boulevard in the city of West Hollywood

\$1.3 million SCRRA – Construct a new Metrolink siding in Sun Valley between Sheldon Street and Sunland Boulevard

\$160,000 City of Los Angeles – Remodel the intersection of Olympic Boulevard/Mateo/Porter Street and install a new traffic signal.



Putting Aerospace Technology to Work in Civil Engineering

The Kings Stormwater

Civil Engineers are fond of saying that what they do is not "rocket science."

Move over, Wernher Van Braun.

Caltrans, together with the aerospace industry and the University of California at San Diego, has just embarked on construction of an experimental bridge that uses aerospace industry-developed carbon-fiber materials for longitudinal girders and fiberglass for the bridge deck. Although not the first use of these materials on a bridge, it is the first on a major highway with heavy truck traffic. Route 86 is a major route for movement of goods to and from post-NAFTA Mexico.

The bridge, on State Route 86 over the Kings Stormwater Channel at the north end of the Salton Sea, is composed of two 9.75 m (32 ft.) spans, 12.8 m (42 ft.) wide, resting on concrete abutments and bents.

UC San Diego designed the bridge in conjunction with the Division of Structure Design. John Pagano and Paul Stevens of Caltrans were project managers for the highway project of which the bridge is a part.

"This is probably the first time in recent history that we were able to do full-scale testing in the laboratory before construction of a structure," says Earl Seaberg, Caltrans Structures Design Engineer. "We tested it at four times the design loadings, and we couldn't make it fail."

Use of the materials was first suggested to UC San Diego bridge expert Frieder Seible by the U. S. Department of Defense. Defense, concerned that the industries it had



Channel Bridge



Photos by Don Tateishi

spawned for the Cold War could not be sustained any longer on aerospace alone, went hunting for uses to which the materials could be applied in an effort to keep those industries viable.

In 1996, the Defense Department suggested to Seible a project whose cost could be shared by the Defense Advanced Research Projects Agency, the aerospace industry, the UC system and Caltrans. Alliant Technical Systems of Salt Lake City, Utah, and Martin Marietta Materials in Raleigh, North Carolina, supplied the materials. Seible tried out the idea on Caltrans Deputy Director Jim Roberts, who sent his Structures Division looking for a suitable application.

"This bridge is a precursor to a composite cable stayed bridge over Interstate 5 at Gilman Drive in San Diego," says Seaberg. "We wanted a project with a suitably short

"This is probably the first time in recent history that we were able to do full-scale testing in the laboratory before construction of a structure..."

span where we could monitor its performance before trying a more ambitious project. We didn't know much about composite materials and the Defense Department and the composite industry didn't know much about bridges. The Route 86 site was the most promising."

Together with the University, Structures developed a bridge that used carbon-fiber tubes, about 355 mm in diameter, as the main longitudinal structural elements, and a fiberglass bridge deck.

The tubes are manufactured by passing woven carbon-fiber cloth filaments derived from heating artificial or

Carbon fiber

Carbon fiber, a polymer, is a form of graphite, which is a form of pure carbon in which carbon atoms are arranged in sheets of hexagonal rings that look like chicken wire.

In carbon fiber, these sheets are long and thin. You might think of them as ribbons of graphite. When bunches of these ribbons pack together, they form fibers, hence the name carbon fiber.

Carbon fibers are not used by themselves. Instead, they're used to reinforce materials such as epoxy resins and other thermosetting materials. We call these reinforced materials composites because they have more than one component.

Carbon fiber-reinforced composites are very strong for their weight. They're often stronger than steel, but much lighter. Because of this, they can be used to replace metals in many uses, from parts for airplanes and the space shuttle to tennis rackets and golf clubs.

The tube-deck panel combination was so strong that testers at UC San Diego could not make it fail.



natural organic compounds to high temperatures through a resin bath and then winding them onto a mandrel, or large spool. When the winding is complete, the carbon-fiber tube is heat-cured to provide necessary strengths and the mandrel is extracted.

The tubes, six for each span, are filled with concrete to increase mass and enhance the load transfer within the tube. These are supported on conventional concrete abutments and bent supports. The tubes are connected to the supports with reinforcing steel.

The deck panels are built up from components that are manufactured by a process called "pultrusion" (the opposite of "extrusion") by pulling fiberglass material through a resin bath and curing oven. The fiberglass is the same material that is found in a wide variety of everyday applications, such as ladders, boats and cars. Special protection is required to guard it from exposure to nature's elements.

The panels are of a web design that is 3 m long and 12.8 m wide, and are anchored to the tubes by steel dowels protruding from the tops of the tubes. Concrete provides shear transfer between the tubes and the deck. After the deck is anchored down, a riding surface of 20 mm of polymer concrete is overlaid on the deck.

Because of the bridge's unique construction, particularly its weight, which is about a quarter that of a comparable conventional bridge, Caltrans was able to do full-scale testing in UC San Diego's structural testing facility. The lab applied cyclic load testing to determine the

bridge's strength, applying two million cycles of repetitive load application.

"We couldn't make it fail," says Seaberg. "We got to four times the design load and couldn't apply any more due to the capacity of the testing equipment." The bridge was tested for structural characteristics of the tube, plus all systems – tube-to-deck connections; barrier rail-to-deck connections; tube-to-support connections; overall performance under load; fatigue and seismic performance.

While the performance of the bridge under testing was highly satisfactory, many questions remain. The bridge will be instrumented for actual load testing, and monitored under use for several years. The Kings Stormwater Channel was chosen because it provided a location where the technology could be tested on short spans; Caltrans bridges typically have 30 to 60 m spans. How the material will perform on spans like those must be determined.

Testing indicates that the structure's response in a seismic event would be superior to that of a conventional bridge; however, its performance in an actual seismic event obviously has yet to be evaluated. The carbon composite material has a

“This technology shows a great deal of promise,” says Seaberg. “It’ll be several years before we have a picture of just how much promise it does have, but we are already using carbon composites and fiberglass column jackets for seismic retrofits.”

very low coefficient of thermal expansion. Using it in conjunction with other materials that have higher coefficients of expansion, such as concrete or steel, will be one of the challenges we face as engineers.

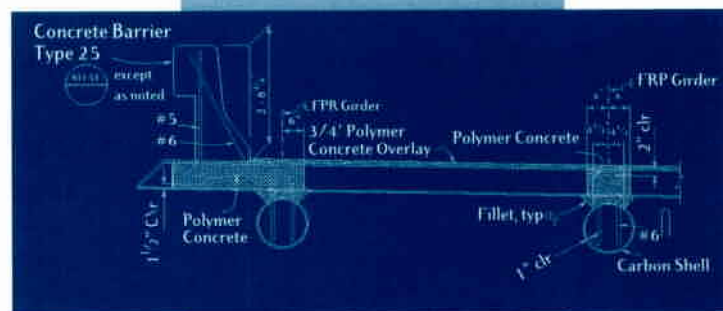
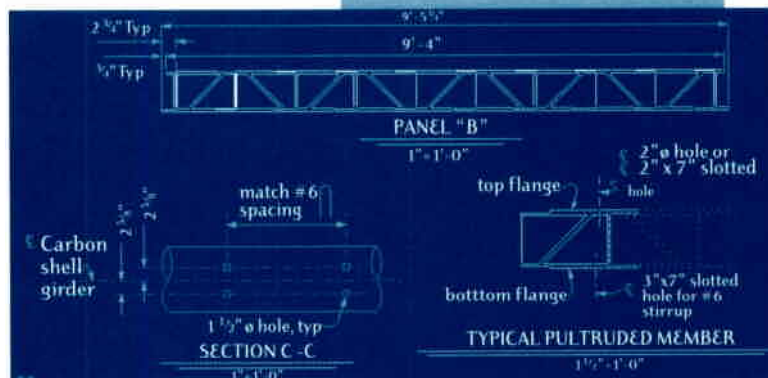
The cost of the Kings Stormwater Channel Bridge is several times that of a conventional structure, but this is “one-off technology.” Costs are likely to drop substantially if the technology makes its way into general use. And because of the materials’ strength it is likely that life-cycle costs will tend to be lower; the material does not need paint and it is inert. There is nothing to rust.

Then, too, while there is an unquestionable beauty in the eye of a structures engineer, the Kings Stormwater Channel Bridge, as it stands today, with its tube and deck construction, probably would not please the average neighborhood beautification committee. If the technology gets into general use, we’ll have to find a way to make it more attractive.

Ultimately, the technology may have specific applications, rather than general ones. Because of its strength and lightness, its ease and quickness of construction appear to be superior to those of conventional structures, making it an obvious candidate for use in emergencies, especially those where construction is necessary under traffic.

“This technology shows a great deal of promise,” says Seaberg. “It’ll be several years before we have a picture of just how much promise it does have, but we are already using carbon composites and fiberglass column jackets for seismic retrofits. We are also planning to use them for the rehabilitation of the Schuyler Heim Lift Bridge decks in Long Beach.

“I expect that as we gain knowledge of how to use the material and industry learns of how to apply the technology to our market we will see a wide variety of applications, including bridge strengthening, repairs, sign structures, sign or light poles, and foundation piling,” says Seaberg. “I can envision other uses for typical installations, such as guard or barrier railing, guard rail posts, concrete reinforcement, large diameter pipes, prefabricated culverts, earth retaining systems and sound walls. The material is best used for high strength applications, especially if site conditions indicate that corrosion can be expected or if lightweight materials are necessary.”



Deck panels are manufactured by a process called “pultrusion,” pulling fiberglass through a resin bath and curing oven.

DESIGNING FOR Maintenance Safety

In the more than 100 years of proud history of the California Department of Transportation, 155 workers on California highways have been killed while trying to perform their duties. Twenty-nine maintenance workers have lost their lives on highway roadsides since 1972 as a result of being struck by errant vehicles. Many more have been injured. These tragic statistics have led Caltrans to a serious examination of designing for maintenance-friendly highways and roadside environments.

In essence, any design feature that requires a worker to be near traffic, whether in a vehicle or on foot, is one that increases the danger for workers. Designs should allow workers to work well away from traffic and even better, behind a physical barrier. Reducing or consolidating the number of maintained roadside features or allowing for mechanical maintenance operations also are important long-term safety concepts.

And, concurrently, most of the features that protect workers also provide benefits to California citizens in the form of lowered maintenance costs, lowered traffic congestion, reduced herbicide use, reduced groundwater degradation, less erosion and longer facility life-cycles.

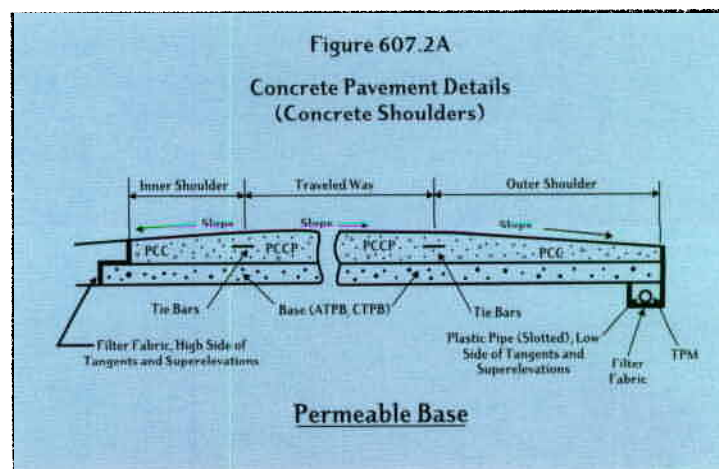
What does this require of design personnel? It means the job of developing maintenance-friendly highway design starts with scoping. Funding for maintenance safety improvements and other features that reduce maintenance life-cycle costs should be included in the cost of the project.

Knowledgeable maintenance staff should be a part of all project development teams, and project plans must be reviewed carefully by maintenance personnel. When developing a Project Initiation Document for the rehabilitation or improvement of an existing facility, the Project Engineer should perform a field review with Maintenance staff to identify features that could put workers in danger or increase maintenance effort.

Maintenance-friendly highway design starts with the pavement. The most dangerous place for a maintenance worker is in a traveled highway lane, even though all possible safety measures are being taken. And the worst enemy to pavement longevity is water. Where appropriate, and especially on busy freeways, new 40-year pavement design standards help meet cost, congestion reduction, safety and longevity objectives.

Only slightly less dangerous than the pavement itself are the median and road edge of a busy freeway. In general, designs should accommodate mechanical, rather than hand maintenance operations. Median plantings should be avoided wherever possible; when local pressure for beautification forces the department to use median plantings, indigenous plants, or those adapted to the local environment and requiring little or no care at all, should be used. (Caltrans' old friend, the oleander, has been a great median planting for years, but now is under siege by California's newest pest, the glassy-winged sharpshooter.)

Where possible, continuous median concrete barrier should be used to minimize the number of visits maintenance workers must make to a highway median. Pavement should extend to the median barrier to eliminate weed control and allow for mechanized sweeping. Remember, sending a crew to work in the median of an operating freeway increases



worker exposure and requires closure of both fast lanes. As capacity is strained on the busiest freeways, even in off-peak hours, this often means traffic congestion.

Recent revisions to the traffic manual provide guidance for the placement of concrete rail at the shoulder. Concrete rail at the outside pavement edge, in lieu of metal, minimizes the number of visits maintenance workers will have to make for repairs. Remember that rail is generally placed in areas that take the most traffic hits. Building in maintenance tasks into these areas increases the risk of worker injury. Pavement should extend to the barrier to reduce weed control and allow for mechanical sweeping.

A fully paved outside shoulder reduces exposure of soils to erosion and allows room for maintenance vehicles to make necessary stops. Designers should also consult with maintenance staff to provide frequent pullouts where vehicles can be parked off the roadway—shielded from oncoming traffic—during operations. Pullouts may be used not only by maintenance staff, but by surveys or designers and others making on-road field inspections.

Designers should group facilities that have to be manipulated by hand, such as traffic and irrigation controllers, well away from the traveled way, and wherever possible, allow access to them from side streets, rather than from within the highway right-of-way. They should be placed on the inside, rather than the outside, of curves, since errant vehicles tend to stray toward the outsides of curves. Access to these facilities at freeway interchanges should be provided from nearby streets, rather than from the freeway.

Access to steep cut slopes should be provided from the top of the slope, to allow for mechanical litter and weed control and to reduce exposure of workers, vehicles and equipment to errant vehicles.

Where possible, designers should provide side slopes that are 1:3 or flatter. This allows the operation of mechanical mowers and other equipment. Flatter slopes not only reduce storm water erosion, they provide a more driveable surface to allow the driver of an errant vehicle to recover control.

Signs and light standards and other appurtenances should be placed well away from the traveled way and, where possible, incorporated into sound walls and bridges, rather than adjacent to them. Water should be channeled away from the roadway toward down drains, which can become clogged, causing sheeting on the highway surface and putting maintenance workers in danger when they have to be cleaned. National Pollution Discharge Elimination requirements mean filtration of drains and will increase the exposure of workers if the drains are not properly placed.

Designers should consider graffiti prevention and removal by using appropriate plantings. Signs and other appurtenances should be as inaccessible as possible to taggers; use shrouds on signs that make them inaccessible to graffiti artists. Access to sound walls for removal of graffiti and debris should be provided from side streets rather than from the traveled roadway.

These tips and others on maintenance-friendly design generally can be found in the Caltrans Highway Design Manual. But there is no substitute for getting to know your counterparts in maintenance. Assuring that maintenance and safety are considered carefully during scoping and design is the responsibility both of Design and Maintenance.



Pullouts reduce exposure of workers and vehicles to freeway traffic



Low-maintenance indigenous plants mean fewer trips to road-sides by maintenance workers.

Next project you get, call up one of the gang with the orange trucks and go out and look together at the project.

After all, if it can be maintained efficiently, your design will look good, function properly, save taxpayers' money and may just save a life.

It's probably not the last piece of the Los Angeles Basin's transit puzzle, but it certainly is a big one that is already having a strong positive effect on the cityscape of California's largest urban agglomeration.

The Los Angeles Metropolitan Transit Agency's new Red Line, operating since June 24 of this year, has had a galvanizing effect on the other elements of the city's public transportation system, causing impressive ridership gains on connecting buses, the existing subway, and Metrolink.

The new \$4.7 billion project was financed partly by more than \$550 million from the State Transportation Improvement Program, plus other State-administered federal funds of almost \$240 million, bringing the Caltrans-assisted financing to almost \$800 million.

More importantly, the opening of the Red Line represents the culmination of a 20-year partnership between Caltrans and the Metropolitan Transit Authority that lasted through a disastrous methane gas explosion, a decision to reroute a major portion of the line in downtown Los Angeles, a \$115 million shortfall, and calls to end the project. When revenues began to fall short during the recession of the early 1990s, Caltrans worked out an arrangement allowing the district to use State funds to continue building as it searched for other financing.

And while Caltrans did not have a formal role in construction oversight, Caltrans' Linda Wright often found herself slogging through unbraced mud tunnels to assure that the progress pay work for which the district was being reimbursed was being done.

Through it all, from preliminary engineering and design through opening day, Caltrans worked with the district to keep the money flowing and to support the project against those hoping for its demise.

The 28 km (17.4 mile) Red Line operates between Union Station in downtown Los Angeles, and North Hollywood. Over its length, the line serves 16 stations between Union Station and North Hollywood. Each of the stations has an

individual design and specially commissioned artwork integrated into its structure and streetscape above, often reflecting the history and character of the surrounding neighborhood with entertaining and whimsical features that make many stations worth a tourist's visit on their own merits.

In a city famed for its fealty to the automobile, the line's ridership has astonished everybody. Within two weeks of the opening of the North Hollywood extension, average daily boardings on the Red Line subway system jumped 89%, from 64,190 to 121,477. Daily ridership on the entire Metro rail system (Red, Blue and Green Lines) increased to 211,015, 42% over the May ridership of 149,050 boardings. This is largely due to the increased connectivity provided by the link to the San Fernando Valley and the success of MTA's newly inaugurated Rapid Bus lines along Ventura Boulevard and Wilshire/

PUTTING THE

Whittier Boulevard. These corridors feed into the Universal City and Wilshire Boulevard stations from the Valley, Wilshire district and East Los Angeles. Red Line ridership has already reached levels MTA had predicted for one year after the final segment's opening.

But the line is beginning to show other cityscape benefits as well. All three Hollywood stations are centers of major redevelopment efforts and economic improvement projects, both public and private, as part of the ongoing "Hollywood Renaissance." A number of joint development projects tied with financial district revitalization, including the Amundson tower and the rehabilitation of the Pantages Theater at Hollywood and Vine are improving the quality of urban life around them.

Linda Wright: "The State has been vindicated in its support of this system. It is now paying off. The light and heavy rail and feeder bus systems are booming. And people who are transit dependent are able to take trips they were never able to take before. That's a real improvement in mobility.

"The partnership that we have developed with the Metropolitan Transit Agency has been tested and found to be a very strong one. As Los Angeles continues to develop its system, we will be there with them."

Federal Transportation Agency
Secretary Rodney Slater joined
Caltrans Director Jeff Morales and
Business, Transportation and Housing
Secretary Maria Contreras-Sweet in
celebrating the Red Line opening.



RED LINE IN THE BLACK



STATE ROUTE 395

California's Newest Scenic Highway

To find Caltrans' newest designated Scenic Highway, it is necessary to ascend to the roof of California. Route 395, snaking along the eastern brow of the Sierra, runs along at an altitude that is higher than most private aircraft routinely fly, with several passes higher than 8,000 feet.

T"This is El Camino Sierra," says Tom Hallenbeck, Caltrans' energetic young manager in District 9. "This highway is really two things," he says. "It is a major interregional route for long distance travel and freight - and it is also the Eastern Sierra's Main Street."

And in addition, in Mono County, it is a scenic wonder.

Your first encounter with Mono County on Route 395 about 45 minutes south of Reno is a spectacular one: Topaz Lake, lying at 1500 m (5000 feet) altitude in today's summer sun and about as topaz as you can get.

Out on the lake, serene on a serene August day, fishing lines cast from lazily bobbing boats lace the water in quest of Topaz's storied trout. Rimming the lake is a brilliant carpet of kelly green, a sharp contrast with the dun and gray of the landscape surrounding it. At the edge of the lake is a gaggle of seagulls, happily getting their feet wet.

The towns along 395—Topaz, Coleville, Walker, Bridgeport—are testimony to a pioneer spirit that braves the awesome winters and arid summers of the eastern Sierra. And between these towns, in the lonely outback of sagebrush and rock, bungalows of various configurations huddle against the elements. A Route 395 traveler pictures their occupants

hunkered down inside, awaiting the arrival of those black helicopters from the UN you keep hearing about, or worse, aliens.

Just south of Coleville, you pass a sign that says this highway has been adopted by a local llama sales operation. Makes sense. A llama would have plenty to do out here in this rocky country, which resembles nothing so much as the arid side of the Andes.

District 9 surely must have the most successful Adopt-A-Highway program in the state. "Mono County folks are proud of their road," says Hallenbeck. "Virtually every stretch of Route 395 that could be adopted not only has been, but there's a waiting list for a lot of areas." Hallenbeck tells of one resident who moved from Mammoth to Santa Barbara, but who would return several weekends a year to do his stint on the roadside.

Walker is the gateway to the Walker River Canyon, where Caltrans showed its mettle five years ago, reopening Route 395 within six months after a devastating flood that washed out most of 16 km (10 miles) of the highway. As you drive south along the river, great gouges in the riverbank give abundant evidence of the river's rampage.





California's Newest Scenic Highway

"I could feel it coming," says Buddy Bayer, Maintenance Supervisor for the Lee Vining Maintenance Station. "It snowed four to five feet in one weekend, then we got a warm spring rain. Everything came down, and when it did, it took the highway with it."

Will the road stay there the next time?

"It ought to," said Hallenbeck, who headed the design team for the reconstruction. "We designed every kind of armor available to us into that highway."



A trip along Route 395 in Mono County provides a shifting palette of color and beauty.

The Walker River reconstruction team won plaudits from a host of agencies for its fix of the river channel as well as of the road. Employing a geomorphologist, Caltrans replaced eddies and river veins and planted the channel with native plant species. So far, it has paid off. Fishing must be good, judging by the number of anglers on the bank. And the road looks like it's there to stay.

Through this canyon, a driver had best leave early for any appointments. On this twisting, two-lane highway, you travel mostly at 65 km/h (40 MPH) in caravans headed up by bulbous RVs towing Volkswagens, followed impatiently by seven or eight macho SUVs. The SUV drivers keep edging over the centerline for an opportunity to pass.

Mono County's seat is in Bridgeport, whose architecture bears the signature of the pioneers who settled there more than a century and a half ago. With the exception of the great white pile of a county courthouse that owes its style more to the ancient Greeks than to Billy the Kid, this is arguably a cow town, plunked down in the midst of a grand high-Sierra valley that looks as if maybe it was the

inspiration for the old Bonanza TV series. Bridgeport hosts an annual rodeo to show you what life in the old west was like.

Heading south for 30 km (18 miles) through pastures, 395 then ascends to the 2480 m (8136-foot) Conway Summit, which yields a breathtaking view of a jewel among a county full of them. At your feet, from a thoughtfully-provided vista point, is Mono Lake, the focal point of a huge natural basin ringed by rugged peaks. Up here, you really can see forever, to mountains as much as 200 km (120 miles) away.

Beautiful as it is, Mono Lake isn't the kind of mountain lake you think it ought to be. No trout here. Alkali and brine have been washing into this lake for millennia, making the lake uninhabitable for the creatures you normally associate with alpine lakes. Nevertheless, it's an ecological soup for the thousands of seagulls that fly in from the coast each year to mate and chomp on the brine shrimp that live in Mono's icky waters.

Mother Nature got pretty creative around Mono Lake. Sagebrush, Jeffrey pines, volcanoes, tufa towers, gulls, grebes, alkali flies and fresh and alkaline waters comprise a world at a transition between the Sierra and the Great Basin Desert. Pronghorn antelope graze in the Bodie Hills while yellow-bellied marmots bask in the summer sun. Great Basin spadefoot toads fill the evening air with a chorus of croaking while nighthawks hunt for insects in twilight. Wilson's Phalaropes feast on alkali flies in preparation for their non-stop flight to South America.

Embracing 14 different ecological zones, more than 1000 plant species, and roughly 400 recorded vertebrate species within its watershed, Mono Lake and its surrounding basin encompass one of California's richest natural areas.

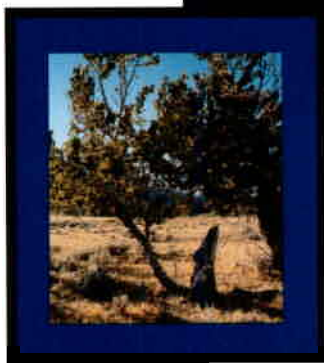
Lee Vining (the town) overlooks Mono Lake. According to Buddy Bayer, who knows just about everything there is to know about Mono County, Lee Vining (the miner) founded Lee Vining. He struck a pretty good vein there, but



later found a better one over in Bodie. Vining's life ended when his gun fell out of his holster onto the floor of his buckboard and shot him.

Bayer, who is retiring in a couple months, has been around this country for most of his life, with the exception of three years when he went off to work on the Nimitz Freeway in Oakland. He's happy to be back in a county whose name, "mono", means beautiful in Paiute. And looking around at these mountains, lakes and high meadows, we'd have to agree with the Paiutes.

Cowtown, county seat, mining town, Bridgeport shows off its Western heritage with an annual rodeo.



South of Lee Vining, you see the first evidence of District 9's objective, worked out with nearby cities, counties, planning agencies and other state and federal outfits that oversee 98 percent of the land up here, to provide a four-

lane highway all the way from Lee Vining to Route 395's junction with Route 14, just above Inyokern. Yeager Construction Company is building a 20 km (12-mile) project to convert the highway to four lanes.

California's Newest Scenic Highway

This is Mother Nature's country, especially today, with the onset of a summer thunderstorm. Virga descends out of puffy cumulo-nimbi; the rays of a blazing August sun remind you of that great old Hebrew National Franks television commercial. It's a painter's palette - azure lakes with brilliant green fringes around them, earth tones on mountains that are dappled by snowy glaciers. A traveler who stops along the roadside is rewarded by the delicate smell of mountain heather.

In the late 1980s, Caltrans tried to fool with Mother Nature along Route 395, as it continues south toward Mammoth, by installing special fences with modules that rotated and, theoretically, aligned themselves with changing winds. That was supposed to drop drifting snow before it reached the highway. The fences worked, but conventional ones were just as good.

Dead Man Summit, 25 km (15 miles) south of Lee Vining, is among the highest of four Mono County summits that, with a good snow storm, can yield a solid 200 km (125 miles) of chain controls. (The dead man, by the way, was a postman trying to get the mail through on skis. The mail eventually got through, but he didn't. Bayer relates that the mailman's boots remain nailed to a tree near the summit.) Route 395 provides an astonishingly smooth ride, in view of the fact that chaining-up is an all-too-frequent occurrence in wintertime.

From this summit, you descend into the awesome Long Valley Caldera, at the eye of which lies one of the nation's grandest ski areas, Mammoth. Those impatient skiers are a good reason behind Caltrans' objective of providing four lanes down to Route 14.

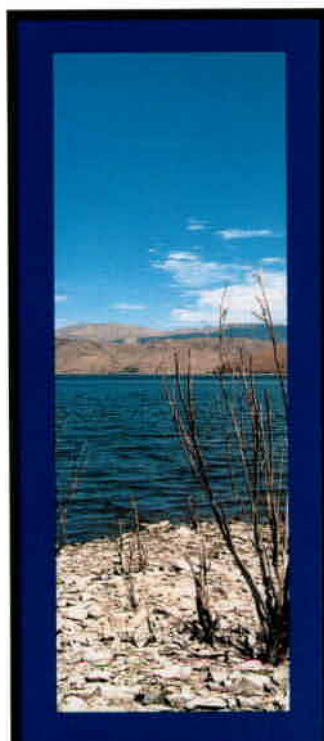
There's a whole lotta shakin' goin' on here. Maybe it's because, as Buddy Bayer says, 21 volcanoes ring the area. The Caldera was formed about 760,000 years ago in an eruption that blasted out 150 cubic miles of magma from beneath the Earth's surface. If you're counting, that's an explosion 2500 times as big as the one at Mount St. Helens. It blew ash all the way to Nebraska and dumped a blanket of regurgitated earth around Bishop that was 150 m (500 feet) thick.

It ain't over yet. Earthquake activity has picked up greatly since 1978 and, mindful of the potential for another blowout, Hallenbeck and his people participate regularly in disaster exercises with other agencies to keep the transportation link open should another earthquake occur.

There's one last outlook as you're descending out of Mono County, this one at Sherwin Summit, where Bishop's great valley spreads out at your feet. To gaze upon the Owens Valley is to know that the Los Angeles Water and Power Agency, right here, defined once and for all the antithetical notions of Northern and Southern California. And that notion lies around water. Whether or not the agency's purchase of water rights in the early 20th century ruined this valley, as some contend, is moot.

The valley as you descend into it, is a welcoming pastiche of greens, almost like a carpet on which you land after flying so high in Mono County.

In all of this, Caltrans sits serenely in Bishop, an outpost far from the hurly-burly of California's busy cities, but nevertheless keenly attuned to its job of keeping travel flowing. And Tom Hallenbeck, Buddy Bayer and their comrades in District 9 intend to keep the Eastern Sierra's main street open and moving, whatever Mother Nature may dish out.



**Mono Lake: an
ecological soup
that nourishes all
manner of exotic
life forms.**

Scenic Highway Program

California's Scenic Highway Program was created by the legislature in 1963 to protect scenic highway corridors from change that would diminish their aesthetic value. A highway may be designated scenic depending upon how much of the landscape can be seen by travelers, its scenic quality, and the extent to which development intrudes upon the traveler's enjoyment of the view.

Local agencies nominate highways for official designation identifying and defining the scenic corridor and adopting ordinances to preserve scenic quality. A scenic corridor is the land generally visible from a motorist's line of vision. If the view extends to the horizon, a city or county may select a reasonable boundary. Minimum requirements for scenic corridor protection include regulation of land use and density of development; land and site planning; control of outdoor advertising, earthmoving and landscaping; and attention to design and appearance of structures and equipment.

A city or county with jurisdiction over lands next to the highway must inspect and evaluate the route to determine if it meets current criteria. It then adopts

a protection program and submits a resolution to the Departmental Transportation Advisory Committee through an appropriate Caltrans district office. After review, the committee can recommend that the Caltrans director designate the highway as scenic.

Caltrans places the colorful "poppy" sign, logo of the scenic highway program, along the route. The poppy logo identifies scenic highways on travel maps, and others produced by the State Division of Tourism.

Official scenic highway status does not restrict highway improvements. However, Caltrans works with appropriate agencies to coordinate transportation proposals and maintenance activities to protect the corridor as much as possible.

Designation does not preclude development, but the program encourages development that does not degrade a corridor's scenic value.

Caltrans checks scenic highways at least every five years to assure that they remain scenic and may revoke the designation if local agencies cease to protect them. In addition, a city or county may request revocation if it no longer wishes to be part of the program.

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by George Hartwell
Office of State Landscape Architecture
Photos by Don Tateishi, Herb Holman, George Hartwell

California

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On any given day in our state, mountaintops may freeze, rain may lash the coastline, snow can race with a blizzard's fury across a volcano's face, or a boiling sun can superheat desert sands. Within California's diverse habitats lies a mantle of vegetation — a spectrum of natural diversity, manifest in every imaginable size, shape, texture, form and color, shifting constantly. Most of the time the change is imperceptible and associated with plant life's complex, interactive relationship with everything else around it, below it and above it.

For California travelers, it's a slow-motion picture of grace, beauty, form and function. Sometimes, however, the change may be overwhelmingly fast and irreversible, the result of human impact on the landscape.

WILD

Wildflowers in Landscape Design

California's *Changing Landscapes*, by Michael Barbour, Bruce Pavlik, Susan Lindstrom and Frank Drysdale, is a contemporary work that speaks to the issue of rapid environmental change:

"Vegetation is the plant cover of a region, the clothing over the land. This thin cloth is at once durable and fragile, able to repair and reproduce itself for centuries if the environment remains stable, but subject to irreversible unraveling when environmental stresses become too severe. When vegetation is disrupted, its integrity is fractured. The degraded cover loses ecological relationships and diversity - both plant and animal."



CaliforniaWILD (California Wildflowers in Landscape Design) is a Caltrans program that seeks to identify, protect and enhance roadside remnant native plant communities. These natural resources are important for their environmental, aesthetic, scientific, cultural and educational values. Some are rare. And although native wildflowers - often displayed in wildly colorful seasonal displays along roadsides - are the showy elements of the CaliforniaWILD program, they are just one part of a natural association that can include grasses, herbs, woody shrubs, trees, mosses, lichens, ferns and more.



Transportation system development affects Nature's delicate balance, making Caltrans' job as steward of natural roadside resources critically important. This role is not unfamiliar. Caltrans works diligently to avoid adverse environmental impacts and, where that is unfeasible, mitigates them.



The components of a healthy native plant community fit together in unique balance, whether on or off the roadside. CaliforniaWILD has identified 20 “botanical management areas” (or roadside reserves) that represent California’s diverse plant communities. The program’s objective is to preserve natural biodiversity in roadside environments, combat invasive weeds that threaten them and discourage human activity that is inconsistent with habitat conservation.

Many of California’s roadsides provide places where natural landscapes can be protected and restored. In some instances, they represent the last physical links that join fragmented vegetation communities. These “DNA super-highways” enable the unimpeded flow of plant and animal genetic continuity from one place to another.

The value of native vegetation was underscored profoundly by Rachel Carson in her 1962 book, “Silent Spring”:

“The earth’s vegetation is part of a web of life in which there are intimate and essential relationships between

plants and the earth, between plants and other plants, between plants and animals. Sometimes we have no choice but to disturb these relationships, but we should do so thoughtfully, with full awareness that what we do may have consequences remote in time and place.”

California’s patterns of vegetation have changed dramatically since European settlers first came to California. Changes in land use increased in frequency and intensity as population increased, cities emerged, agriculture converted native grasslands to non-native species, and highways were built to link farm and market, town and city.

The introduction of non-native, invasive species—either intentional or inadvertent—wrought catastrophic environmental change to much of California’s natural landscape. Perhaps nowhere is this so apparent as on roadsides. And that’s what travelers see most often, up close and personal. Noxious weeds that exist in natural balance in their place of origin, without environmental factors that keep them in check at home, have invaded roadside natural areas with a vengeance and have displaced native



vegetation, sometimes completely. The environmental and economic costs of these noxious weed invasions are immeasurable. Still, many California roadsides, even grossly degraded ones, represent a repository of the natural landscape and offer the potential for restoration.

The Federal Highway Administration, implementing national policy, law and executive order, has assisted states, including California, in developing “environmentally beneficial” landscape practices that require the use of native plant materials whenever possible. Other guidelines prescribe cooperation in the nationally driven effort to eradicate invasive weed species from state highway roadsides.



A renaissance of awareness of the need to protect California’s natural heritage, restore what we can and control invasive weed species has changed in great part the culture of Caltrans and the way we think of roadsides.

In the 1930s, the national concept that “America’s roadsides are America’s front lawns” produced a manicured, irrigated roadside landscape comprised mostly of non-native plant species.

Formal, irrigated, non-native landscapes still play an important role in providing a pleasant interface between transportation infrastructure and communities in urbanized California. Rural and suburban roadsides, however, may be viewed much differently. In these special places, programs like CaliforniaWILD and others can help maintain and restore natural wildflower meadows, native grasslands, chaparral scrubs, mountain forests, desert habitats and other remnants of California’s great ecological diversity.

And if, in doing so, our roadsides present travelers with a great splash of natural color, so much the better.



Victorian Streetlights Return

TO HISTORIC LOS ANGELES DISTRICT

Turn-of-the-century Victorian streetlights once again grace the 80-year-old Adams-Figueroa Historic district, near the University of Southern California between Exposition Park and downtown Los Angeles.

Caltrans officials and Los Angeles community leaders are celebrating the completion of a project to install 33 identical replicas of the original 1906 streetlights that were removed when Figueroa Street was widened during the Harbor Transitway construction.

"This project is a unique example of how federal, state and local agencies can work together to provide community improvements in a large metropolitan area," says Caltrans District 7 Director Robert W. Sassaman. "We are pleased to have played a role in helping to restore the historical character of the Adams/Figueroa neighborhood."

In 1991 the City of Los Angeles proposed replacing the original streetlights with modern, high-intensity cobra heads that were a far cry from the ornate, warmly glowing, pedestrian-friendly lights that residents had cherished since the 1920s.



When the Caltrans Environmental Planning team assessed the impact of construction on the historic neighborhood, it determined that, although its ambience had deteriorated over time, many significant structures still remained. To give the streetscape an echo of its former glory and to leave the neighborhood better off as a result of the highway-widening project, staff proposed returning the streetlights and mature trees to Figueroa Street.

Caltrans landscape architect Bill Nagle developed a plan to install more 1906-style lights than had been removed, plant 30 large Sycamore trees on Figueroa Street between 21st and 33rd streets and on Adams Boulevard between I-110 and Figueroa and install new, red-textured pavement in front of the historic Auto Club building.

Thanks to detective work by Diane Kane, Caltrans architectural historian, a surprising discovery was made—Union Metal Corp. of Canton, Ohio, the manufacturer of the original lights, was still in business. And the original ironwork molds used to cast them were still in a factory storage room. Russell Poling, an executive with Union Metal, said, "It was a custom design for Los Angeles." He added, "Our forefathers were very bright. They planned for this nostalgia to come back. They just didn't know it would take this long."

According to Diane Kane: "When I did the environmental review of the project area, I noticed that the original turn-of-the-century street lights had been sorely beaten up and cannibalized over time by neglect, vandalism and haphazard modern replacements. There were still a number of operational fixtures, but they were adjacent to modern buildings, while the historic buildings had modern fixtures in front of them. Since the streetscape was such a hodgepodge, I thought repairing the original fixtures and returning them to the sidewalk in front of the historic buildings was a nice idea—it wasn't mitigation, it was an enhancement."



The Adams/Figueroa corridor had some very well-organized, vocal neighborhood groups who felt passionately about their remaining streetlights. Previously concerned about additional traffic into their area from the project, they were impressed and supportive of the concept of restoration. As a direct result of the historic lighting project, they dropped their opposition to the widening and helped convince the Bureau of Street Lighting to restore the historic lights.

The new light posts look identical to the originals. However, the replicas were redesigned on the inside to meet contemporary safety codes and standards. They have 18-watt fluorescent bulbs instead of the 400-watt, high-pressure sodium bulbs used in the cobra-style modern streetlights. Each replica light standard cost \$10,000. Property owners agreed to pay an extra fee to the City of Los Angeles for maintenance.

Many of the city's elegant and elaborate streetlights are disappearing. This project gave those involved a greater appreciation of historic and ornamental streetlights as works of art. Community leaders predict the antique look will be so popular that other Los Angeles property owners will want them, too.

Ms. Kane continues to work with the Los Angeles Cultural Affairs Department to inventory the remaining lights and to develop an overall plan to protect and preserve them, possibly on bikepaths or in historic residential neighborhoods, using TEA monies. Another spillover effect is the possibility of extending the ornamental lighting on Figueroa northward to the Convention Center and Staples Center as part of the entryway into downtown from the Transitway.



ROUTE 30

A NEW HIGHWAY ON A NEW COURSE



The most massive set of projects on new alignment on a single route in California today is forging a new east-west link between Los Angeles and San Bernardino counties. Adopted as a freeway in 1949 by the California Highway Commission, considered for rescission in the late 1970s, and raised from the dead by vigorous local support in the early 1980s, the \$1 billion State Route 30 project, both literally and figuratively, is breaking new ground.

Route 30's mix of financial stakeholders is typical of the world of construction at the turn of the century. The project consists of 11 segments funded through a complex financial stew of San Bernardino County's half-cent sales tax measure passed in 1989, Los Angeles Metropolitan Transportation Authority's (MTA's) Measure C, and several kinds of State, federal and local money. And this intricate financial arrangement brings together a host of governmental agencies, including the Federal Highway Administration, the San Bernardino Associated Governments (SANBAG), MTA, both counties and seven cities, to look over the shoulders of Steve Keel in District 8 and Marco Ruano in District 7, who are managing the projects. At the completion of the Route 30 project, Caltrans will apply for designation as Interstate 210, allowing some reimbursement at Interstate Program ratios to the many financial partners in the project.

When the 16 route segments are completed, the freeway will extend between Route 66 in La Verne and Interstate 215 in San Bernardino, stretching 45 km (28.2 miles) and providing a third alternative to the crowded Interstate 10 and State Route 60. Between La Verne and San Bernardino, the freeway will pass through Claremont, Upland, Rancho Cucamonga, Fontana and Rialto. In San Bernardino, it will connect with an existing freeway that passes through Highland and ends in Redlands at Interstate 10.

River stones embedded in the project's structures are a continuing feature, since they appear throughout the cities and towns through which Route 30 passes. Many historic buildings affected by the project are faced with river stones.

State Route 210 (30) will include eight travel lanes (including 2 HOV lanes), freeway-to-freeway interchanges with Interstates 15 and 215, 16 local street interchanges, two future interchanges, and one HOV interchange. Much of it will be depressed below existing streets so as to be less obtrusive to the nearby cities. Storm drain channels, required by infrequent but heavy rains in the nearby San Bernardino Mountains, also will cross over the top of the freeway in several locations.

Route 30's complex finances also have created a complex environment for project development. SANBAG is designing eight of the 16 route segments and overseeing construction on six of them. Caltrans is designing eight segments and overseeing construction of 10, including the massive interchanges with Interstates 15 and 215.

Managing the 30 km (18 miles) of the route in San Bernardino County is a new kind of Caltrans manager: Steve Keel, one of the few Caltrans project managers who is not a civil engineer. Keel, who has been with Caltrans for 20 years, has spent most of his career with the Route 30 project, starting as a transportation planner working with local agencies in developing the route concept and continuing as the manager of the environmental analysis of the route.

Because local agencies in San Bernardino anticipated that the route would be built and preserved much of the open land for it, the project development process was able to proceed with relatively little of the *sturm* and *drang* that often accompanies billion-dollar projects.

"That doesn't mean it was a cakewalk," Keel says. "Placing a major project in an urban area always results in some controversy, but the strong support of the local agencies was a positive factor for the project."

The project affects a number of valuable cultural resources, including historically significant homes and other structures, and will take more than 200 residences. (Most of the right-of-way has now been cleared and, as your airplane from Ontario Airport passes through 1000 m (3000 ft.) altitude, the corridor becomes easily identifiable.)

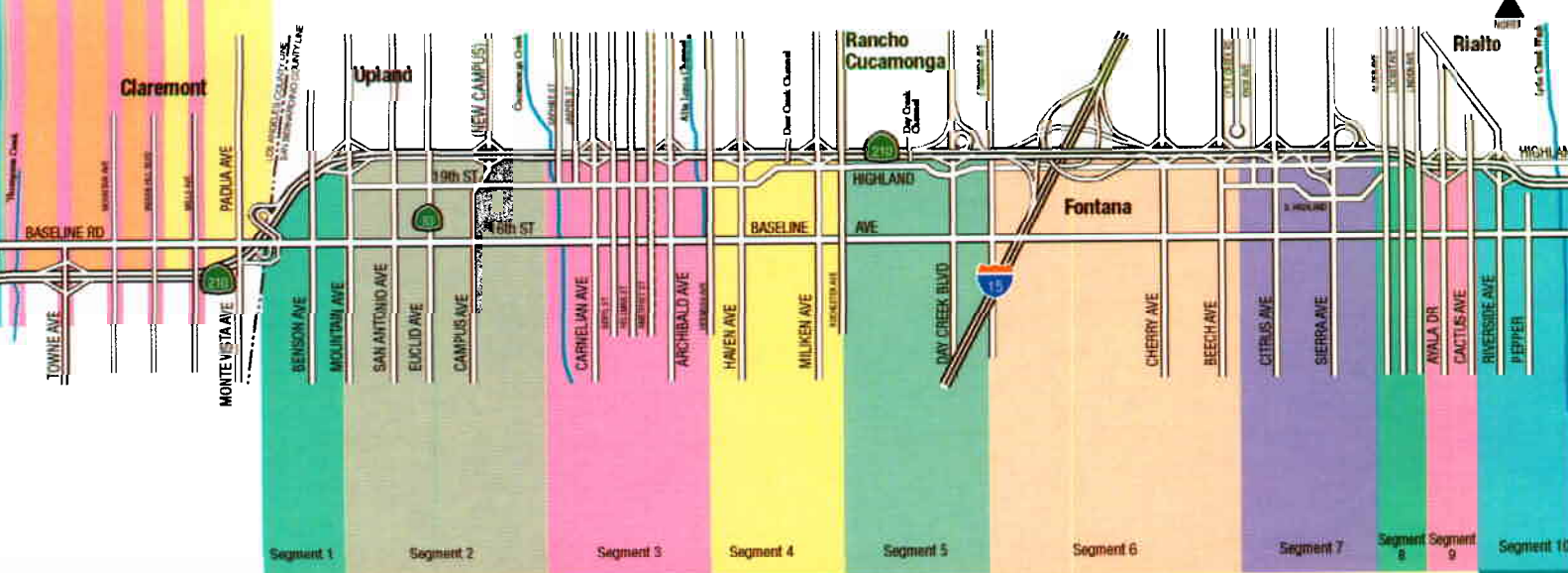
Among the project's acknowledgements of nearby cultural features is the construction of the Euclid Avenue Overcrossing, part of a historic linear resource that is lined with trees and cobblestones. To assure its continuity, Caltrans removed and curated the cobblestones, then replaced them on the overcrossing. The structure is also lined with citrus trees, which required additional depth.

River stones embedded in the project's structures are a continuing feature, since they appear throughout the cities and towns through which Route 30 passes. Many historic buildings affected by the project are faced with river stones.

The project also affects the residence and studio of Sam Maloof, one of the nation's foremost woodworkers. The County of San Bernardino secured new property for Mr. Maloof and is moving his residence and studio, both masterworks of craftsmanship, to that location.

Mitigation was also required to replace alluvial fan scrub and woolly star habitats, southern oak woodland and other native trees, as well as the San Bernardino Merriam's kangaroo rat. Overall, the environmental impacts of this large project were relatively mild.

Today, three major segments of the main line are under construction, as are a number of undercrossings and overcrossings that will provide local traffic circulation while the main line is being built. The biggest current project, at a cost of about \$86 million, is the interchange with Interstate 15,



State Route 210 (30) will include eight travel lanes (including 2 HOV lanes), freeway-to-freeway interchanges with Interstates 15 and 215, 16 local street interchanges, two future interchanges, and one HOV interchange.

under construction since March 1998 and on schedule for completion early in 2001. Nabil Fraywat is the Resident Engineer on the project, and Mike Beauchamp is the Structures Representative.

A big job with almost 1200 plan sheets, the project will ultimately result in movement of 2.2 million m³ (2.8 million cubic yards) of dirt, including about 800,000 m³ (one million cubic yards) of roadway excavation. The project involves 21 structures, including one 1000 m (3300 ft.) freeway-to-freeway connector. Yeager Construction, the contractor on the project, is building

most of the overcrossings on waste slabs so as to save the cost of falsework. Yeager is also the contractor on the two adjacent route segments, allowing it economies of scale and an opportunity to open almost 10 km (six miles) of the route together at the completion of the job.

The highway's main line is a 50-year pavement design with an asphalt-treated permeable base over an impermeable membrane and edge drains to keep water from the sub-base. Seventy-seven change orders have been required so far, many of them to meet Interstate Standards because of the highway's eventual Interstate designation.

The most serious construction problem is wind. The project essentially lies in the funnel that both on-shore and Santa Ana winds use to traverse between the Pacific and inland Southern California, whipping occasionally to a sustained 160 km/h (100 mph).

With thousands of m² of disturbed ground, these winds, which are capable of moving pebbles as much as 25 mm (one inch) in diameter, sometimes whips up an awesome dust storm that is unacceptable both to nearby residents and the Air Quality Management District. The original contract called for the contractor to use water as a dust palliative, but the first good wind that came along demonstrated that there weren't enough water trucks in Southern California to keep the dirt in place. The solution, to use *Suppress*, a Pennzoil product, was a model of how partnering between Caltrans and its contractors can work (see opposite page).

As construction has begun in areas that were cleared several years earlier or were undisturbed, rodents (not the kangaroo rats which Caltrans traps and relocates, then fences off rat-free areas for construction) have high-tailed it out of the right of way and into nearby residential areas. This has kept Mike Lopez, a community liaison on the Los Angeles County end of the project, busy helping the project's neighbors. Construction noise also is an issue for nearby residents, who, until now, have had a buffer several hundred meters wide from any activity.

One of the most contentious issues for the contractor and for Caltrans is protecting disturbed ground from pollutants - the Storm Water Pollution Protection Program. Construction is inherently a messy business. Inspections for oil leaks and other kinds of waste matter are rigorous; nevertheless, there have been no shutdowns and the project is proceeding at a vigorous pace.

When completed, Route 30 will cease to exist and Route 210 will extend effectively from Route 5 to Route 10 in Redlands, a distance of more than 120 km (75 miles). It will relieve the hard-working Interstate 10 and State Route 60 and provide additional mobility for motorists and commerce throughout the foothills of the San Bernardino Mountains.

Osama Hassoun (most folks call him Sam), Caltrans' specialist in partnering, points to the Route 30/ Interstate 15 Interchange construction project as one of the most successful examples of partnering ever accomplished on a construction project.

The partnering process consists of formal steps to agree on how to look for better ways to get the project done, resolve differences and establish clear commu-

*Caltrans and its construction contractors
are getting together as never before to
solve problems and keep jobs on schedule
and within budget.*

PARTNERING GETTING IT TOGETHER IN CONSTRUCTION



nications between the department's and the contractor's teams. The formal steps include a pre-construction meeting, making an offer to partner, holding a kickoff partnering workshop, conducting regular meetings and team building activities, and going through formal resolution when disputes arose.

"The partnering atmosphere for the Route 30 project was set both by Caltrans management and that of the contractor," says Hassoun. "Then-R&E Bryce Johnson, Structures Rep Mike Beauchamp, and E. L. Yeager's construction superintendent, Ron Renslow, really made it work."

Nabil Fraywat, Caltrans' current R&E on the \$86 million interchange project, says that when he arrived on the job, Caltrans and its contractor already had an atmosphere of trust and accommodation.

Thus, when the issue of dust control during the violent Santa Ana winds came up, he and Renslow started looking for a solution together. They found that Pennzoil's *Suppress*, an environmentally safe petroleum emulsion that had been used only in trials to that date, could hold the soil during violent windstorms. Fraywat

expedited testing of the material and getting approval from local authorities. He and Renslow also agreed to a shared-cost arrangement and developed a change order to allow its use.

In another instance, the on-the-job inspectors found that Yeager's #4 inch screens were out of specifications by two percent with a major pour coming up at 6 am the next day. Fraywat notified Renslow immediately of the problem, which could have shut down the job, and then arranged for additional testing at 5 the following morning. Renslow kept the job moving while he checked out the screens, found the problem, and got it fixed. The pour went on as scheduled.

"That's the spirit of partnering," says Fraywat. He is backed up by Yeager's Renslow, who observes that there is both a natural conflict and a partnership between the department and its contractors, and that partnering has helped to offset the conflicts and solidify the partnership.

And, says Sam Hassoun, the proof is in the interchange project itself, which so far is proceeding on schedule, within budget and with only minor unresolved disputes.



Soil Nail



The California Department of Transportation has been actively implementing Soil Nailing technology for excavated slopes since the late 1980s. This technology surfaced in France in the early 1970s as a spinoff from European tunneling excavations where grouted steel rods were used to knit and support potentially loose rock slabs. French engineers were quick to notice the advantages of extending this tunneling practice to support excavated, near-vertical soil slopes, because of dramatically reduced costs over traditional methods of slope stabilization. During this time, the French engineers coined the construction term “soil nailing,” referring to the percussion method of installing the bars in early slope stabilization schemes.

Technology

Soil Nailing is a “top-down” construction process that consists of a soil slope excavated to a vertical, or near-vertical orientation in 2-2.5 m high (6-8 ft.) lifts, internally supported by closely spaced steel reinforcing bars fully grouted in place. The bars are placed in an inclined downward drill hole and gravity filled with high slump grout for developing anchorage to the surrounding soil. The bars are spaced at center to center distances of 1.2 to 2.5 m (4-8 ft.), with the tighter spacing with weaker soils. Potential soil movements are immediately resisted by stress increases in the bars; thus, no bar pre-stressing is required as in tieback wall systems. The exposed soil face is covered with a 100-150 mm (4-6 in.) shotcrete layer reinforced with steel rods and/or wire mesh for additional support.

The National Cooperative Highway Research Program on soil nailing contained the following summary of the benefits of this concept in a 1987 research report:

Low cost: In soil nailing, the in-situ ground is used as one of the main structural elements in the retaining structure, the other structural element being the relatively low-cost

nails. The shotcrete or prefabricated facing has only a local role, preventing the collapse of the soil at the face between the nails. The facing is therefore relatively thin and inexpensive. The low cost of the elements can provide significant savings in construction materials compared to conventional solutions, which generally require thick reinforced concrete facings or prestressed ground anchors.

Light construction equipment: Soil nailing uses simple drilling and grouting equipment (drilling by vibropercussion and grouting generally by gravity). The handling of equipment is relatively easy because of staged construction, making the technique particularly useful in sites with difficult access.

Adaptability to site conditions: Application of the system is flexible because the staged construction process allows the geometry of the structure, the inclination of the facing, and the density and dimensions of the reinforcements to be adapted to the site conditions and soil characteristics exposed at different levels during excavation.

Easy operation in heterogeneous soils: In heterogeneous ground, where boulders or hard rocks may be encountered in softer layers, soil nailing is generally more feasible than other techniques such as slurry walls and soldier piles, because it involves only small-diameter drilling for the installation of the inclusions.

Flexibility: Nailed soil retaining structures are more flexible than classical cast-in-place reinforced concrete retaining structures. Consequently, these structures can conform to deformation of surrounding ground and withstand larger total and differential settlements. This characteristic of soil nailing can provide economical support for excavation on unstable slopes.



methods were established for defining the stress state of the reinforcing elements and overall factor of safety for the completed, excavated and nailed slope. Since these calculations were quite laborious, the Office of Roadway Geotechnical developed the computer program SNAIL to evaluate bar stresses and stability factors. The program reduced computational time from days to minutes and was the most significant factor in promoting soil nailing within the department.

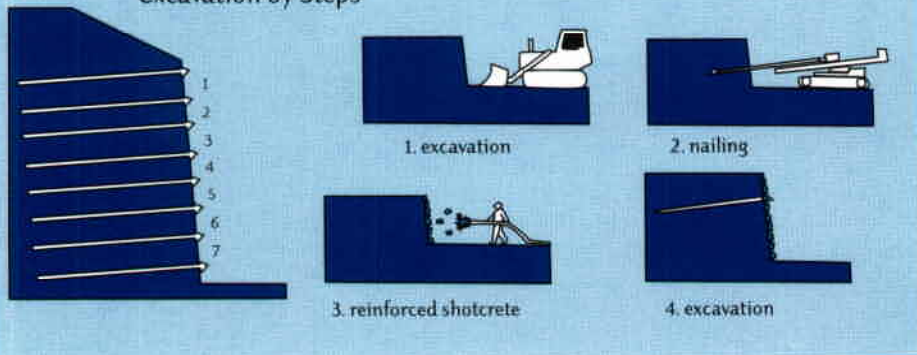
Soon after the San Diego wall was constructed, other walls were placed on the design board by consultants in various California cities and counties who were working on locally funded projects. Since Caltrans was acknowledged as the authority for the design standard, many of consultants asked for the program to help them in soil nail design efforts. Eventually the program was distributed worldwide and is currently on the Internet.

The greatest benefit of this construction method is its reduced costs over other traditional methods of stabilizing and supporting cut slopes. Normally concrete cantilever walls, or gravity walls of the engineer's choice, were constructed but were generally more costly since over-excavation was necessary to provide sufficient base width for the wall system. This over-excavation was even more costly when high slopes were encountered, or if buildings or pipelines above or behind the proposed wall existed. As an example, a typical soil nail wall on the order of 5 to 7 m (17-23 ft.) high can be constructed for approximately \$375 per m² of face (\$35 per square foot) at 1999-00 costs, whereas a traditional wall type, such as a concrete cantilever wall, would typically run about \$590 per m² of face (\$55 per square foot).

Soil nailed walls as high as 16.8 m (55 ft.) have been designed by Caltrans engineers, two of the more notable

Soil Nail Technology

Excavation by Steps



The first known implementation of a soil nail wall in the United States was the privately contracted Good Samaritan Hospital in 1976 in Portland, Oregon. Caltrans became one of the first departments of transportation to implement the concept with the design and construction of a small 3 m (10 ft.) high soil nail wall on State Route 163 in San Diego, in 1987.

The analysis process for this 'first start' soil nailing project required a considerable literature review by geotechnical engineers at the Transportation Laboratory into how the evaluation should be conducted. Also, research was conducted into the stresses likely to be encountered in the steel shotcrete face reinforcement, based on a theoretical estimate of lateral soil pressures at the soil-shotcrete interface, as well as at the nail head connection detail. Initially, hand calculation

That Caltrans leads in this technology is attested to by requests for information on program use and design specifications from engineers from other state departments of transportation.

being in Santa Clara and Sonoma counties for landslide control and designed by Hooshmand Nikoui of the Office of Roadway Geotechnical Engineering. Currently, another notable wall is being designed for the San Francisco Bay Area that will be 24 m (80 ft.) tall. This wall, at the new Carquinez Bridge, will be temporary and restrain the cut slope for construction of the north anchorage. Soil nail wall designs in Caltrans are typically provided by the Office of Roadway Geotechnical Engineering with the Division of Structure Design developing a thicker structural PCC overlay when the wall is designed as a permanent structure.

Face treatments can be embellished to enhance the wall's appearance. Wall aesthetics are quite important as Caltrans moves to satisfy nearby residents and motorists in an era of commitment to environmental sensitivity. Wall cost for such architectural treatments are nominal, generally less than \$21 per m² of wall face (\$2 per square foot). Almost any color and face sculpture can be provided.

The accompanying photo illustrates a recently completed wall on State Route 92 in San Mateo County. Wall height is over 15 m (50 ft.) and constructed at a cost of approximately \$800 per m² of wall face (\$75 per square foot). The walls were constructed for roadway widening in steep terrain and in a complex geologic setting that required specialized and expensive drilling techniques. However, wall costs were still significantly less than for the wall type that would have been proposed as a traditional alternate, a soldier-pile tieback wall at \$1200 per m² of wall face (\$110 per square foot).

Over the past 13 years, more than 185,800 m² (2 million square feet) of soil nailed walls have been constructed in California alone, with Caltrans projects directly (or indirectly, because of consultant-designed projects under locally funded measures) accounting for the vast majority.

Savings are conservatively estimated at a minimum of \$160 per m² (\$15 per square foot) of wall face for total cost savings of at least \$30 million.

That Caltrans leads in this technology is attested to by requests for information on program use and design specifications from engineers from other state departments of transportation. FHWA also has promoted this design concept by providing a manual of testing and design procedures developed through contract with Golder and Associates of Redmond, Washington. The manual ("Manual for Design & Construction Monitoring of Soil Nail Walls") goes into depth on theory, case studies, research, and design recommendations, and is quite useful to the practicing geotechnical engineer already knowledgeable in the rudiments of soil nailing.

The soil nail wall as a primary 'top down' steel reinforced gravity structure is here to stay. It is beyond its infancy in production in California and is gaining wide acceptance with other departments of transportation. Use of the technology will likely increase substantially in California over the next decade as the population increases and the governor's commitment to increasing public transportation mobility is implemented. Because value is a key to this commitment, new engineering methods such as soil nail technology will go far in meeting this objective.



Speeding **Project** *to Com*

Concerned with a fat cash balance in the State Highway Account and lagging delivery of locally funded transportation projects, Caltrans has been in the midst of a multi-year effort to make funding and project development processes more flexible and accessible to those using them.

The changes, which are estimated by some local officials to have the potential of reducing project development costs by as much as 20 percent, have been aided by two pieces of legislation by Assemblyman Thomas Torlakson, AB 1012 and AB 2928.

The outcome of these efforts, which involved a partnership with federal, State and other local agencies, has been additional flexibility and cooperation between the agencies, resulting in a substantial improvement in delivery of local agency projects. In 1999-2000, the local agencies delivered 140 percent of the projects that were originally planned, reducing congestion and cutting into backlogs of aging and damaged facilities. Other measures that pertain strictly to State projects have promise of producing positive results.

In general, Caltrans' changes to its project development process lie in five areas:

NEPA/CEQA issues

Using federal dollars more flexibly

Better integration with permitting agencies

Providing assistance to local agencies

Easing cash flow

pletion

Among the measures adopted were several that flowed from Assemblyman Torlakson's follow-up legislation, AB 2928. For instance, local agencies may substitute State-only funds for federal funds, reducing the number of agencies involved in reviews of the projects and allowing the local agencies to comply with State environmental processes, rather than the more cumbersome federal ones. (Local agencies must still comply with applicable laws regarding endangered species and cultural resources.)

The State also put more resources to work in helping local agencies develop their projects. Local agencies, especially the smaller ones, are not regularly called upon to process projects that must comply with federal regulations. The result is that each such project results in a kind of reinvention of the wheel; with State experts assisting them, the agencies are able to move more quickly and with greater efficiency.

AB 2928 also addressed a problem that had developed in the State Transportation Improvement Program, one that affected both State projects and locally financed ones: the program covered only four years. Because of the complexity of environmental and other regulations, four years simply was not enough time in which to develop a project from concept to start of construction. As a result, projects that were in the normal project development pipeline looked as if they were being delayed.

Assemblyman Torlakson's legislation added a year to the program, but also allowed both the State and local agencies to finance two additional years of advanced development work – planning, preliminary engineering and environmental analysis before tying up funds for capital outlay.

With regard to its own projects, Caltrans began to rethink the steps in its project development process. It had been

To combat this the department initiated a “change control” effort which consisted of doing surveys, mapping, bridge site investigations and environmental analysis prior to the Project Initiation Document. The department also began doing field investigations with the permitting agencies in the Project Initiation phase, thus getting a much better picture of what those agencies would need for resource avoidance or mitigation.

One problem was that the permitting agencies often did not have enough staff to become engaged in the projects at this early stage. And they often did not have enough staff to do a timely and thorough analysis of the department's proposals when Caltrans came to them for needed permits. To solve this problem, Caltrans requested and received an additional 20.5 personnel years in its budget in order to place environmental staff in those agencies to work

*The department also began doing field investigations with the permitting agencies in the **Project Initiation phase**, thus getting a much better picture of what those agencies would need for resource avoidance or mitigation.*

generally unable to get agreement from the permitting agencies – Fish and Wildlife, Environmental Protection Agency, U. S. Army Corps of Engineers and others – early in a project's developmental life-cycle. This often meant disagreements on environmental matters after the scope of a project had been set. At worst, this meant going back to the drawing table and re-designing the project. At best, it often meant many months of haggling over project features and environmental mitigation.

Caltrans also found that it occasionally fixing the scope of the project before all adequate information was available. This resulted in changing the scope, schedule or cost of the project after it had gotten into the State Transportation Improvement Program or the State Highway Operations and Protection Program. Such changes amounted to broken promises.

exclusively on transportation projects. This is expected to provide timely decision-making and to reduce the amount of bureaucratic warfare that had formerly plagued project development.

The teams engendered by Assemblyman Torlakson's legislation made almost 200 suggestions overall. Because the teams worked independently from four separate geographic locations, many of the recommendations were overlapping. But the recommendations covered all areas of project development – from programming issues through construction. Caltrans is continuing to evaluate these recommendations and to adopt those that appear to have utility in the project development process.

AB 1012 *called for:*

- 1** Creation of advisory teams to look at ways to speed project delivery.
- 2** A comprehensive project management information system.
- 3** Providing longer lead-times and early funding of project activities for more complex projects.
- 4** Allowing Caltrans to do work on a reimbursement basis for local agencies.
- 5** A loan program to allow local agencies to use State funds on local projects.
- 6** New project development Study Report Guidelines.
- 7** A "Use it or lose it" provision, requiring local agencies to make unused funds available to other agencies.

Response to **AB 1012**

- 1** Caltrans is studying 191 recommendations for speeding project delivery made by the advisory teams.
- 2** The California Business, Transportation and Housing Agency is spearheading a proposal for the management information system.
- 3** Longer lead-times and early funding have been put into effect.
- 4** Caltrans is providing reimbursed assistance to local agencies when asked.
- 5** The loan program is in place.
- 6** Guidelines for Project Study Reports have been released.
- 7** Local agencies have responded vigorously to put their funds to work so as not to lose them.

Whither metric

10

The metric winds, it seems, blow hot and cold. Every few years, enthusiasm rises for the system of weights and measures that has been embraced by every nation in the world except the United States and Myanmar, formerly Burma. But just as the night follows the day, an equal and opposite disenchantment arises to turn back the tide of joules, ergs and hectares.

But Caltrans remains officially metric, even though enactment of the Transportation Equity Act for the 21st Century, signed by President Clinton in 1998, removed the federal mandate for full conversion. When TEA-21 gave the option to each state to remain English, California—along with the majority of other state departments of transportation—decided to stay metric. Since then, numbers of states have reverted to English units, and a recent survey found 14 states committed to metric, 30 to English, and six using dual English and metric units.

America's metric movement goes back to the Metric Conversion Act of 1975, which declared a national policy of encouraging the increased use of the metric system. This effort was to be voluntary and, it was hoped, would be led by industry, which was finding itself increasingly isolated in an ocean of metric products. Although steam grew for conversion, support for it was not widespread. Then, in 1988, Congress passed the Omnibus Trade and Competitiveness Act, amending the 1975 act to declare that the metric system was the preferred system of weights and measures for U.S. trade and commerce.

That act required each federal agency to adopt the metric system in its procurement, grants, and other business-related activities. The Federal Highway Administration developed a five-year Metric Conversion Plan, approved by the Secretary of Transportation in 1991, requiring the states to be metric by October 1996.

Then, however, the National Highway System Designation Act of 1995 pushed the conversion date to October 2000. TEA 21 removed it altogether.

FHWA has indicated that it will remain metric in its internal operations. The agency uses dual units with the metric value first, followed by the inch-pound value in parentheses, for correspondence or publications intended for broad audiences. These include publications such as right-of-way or environmental clearance documents and general information. Research reports prepared under FHWA planning and research grants must contain metric units. All other FHWA documents should include metric units.

Caltrans notified local agencies in August of 1998 that they could use either English or metric units on projects off the State highway system, but they must use metric units on projects for any projects on the system. The department amended that policy in October 1999, allowing dual units for encroachment permit projects (those with a cost of up to \$1 million within the State right-of-way).

With declining availability of 1992 English Standard Specifications and the latest English Standard Plans becoming obsolete, local agencies and other customers who wish to use Caltrans highway contract documents will have either to switch to metric or use the Standard Specifications for Public Works Construction (the Green Book), depending on the project. The 1997 version of the Green Book, published by AASHTO, is available in dual units and may be used for encroachment permit projects.

The change to metric units did not come without concern from our external partners. Many local agencies have routinely used Caltrans' contract specifications for years.

C?

To assist, Caltrans makes a tailored set of boilerplate contract documents for Federal-aid projects available to local agencies on the Internet. The department is also considering creation of a set of soft converted standard specifications, special provisions, and standard plans from metric to English units for local agency use off the State highway system. If the department takes this step, it will absorb the administrative cost as a gesture of partnership with local agencies.

Exceptions to the metric policy are still handled on a case-by-case basis. Projects granted exception to the metric policy must follow the April 15, 1998 memorandum on processing metric exceptions, and reiterated by a second memorandum on April 21, 2000 that listed projects that were to be exceptions. As Caltrans advertises fewer and fewer projects with approved metric exceptions—those listed in the April 21, 2000 memorandum—it moves closer to a time when all projects will be metric.

At Caltrans, we will use metric values when doing our work, although for external purposes, the department will continue to publish documents with metric values followed by English equivalents for the foreseeable future.

By Jeff Morales

Director, California Department of Transportation

Sudu Chalan — Keeping Indian Culture Alive in the U.S.

Sudu Chalan, when he is not busy streamlining the project data of various District 12 programs into one database to be accessible through inter/intra net, occupies himself with being one of the world's top performers on the harmonium, tabla, ghatum, mridangam and veena.

Born to a family of musicians in Bangalore, India, Sudu sings and performs on the above instruments in two styles of Indian music, Carnatic and Hindustani. He has produced many two-hour musical ensembles for 15 musicians in India and the USA, and led 65 adults and 30 children in a one-hour musical dance/drama/float presentation, "Karnataka Andhu-Indhu," for the Karnataka Cultural Association of Southern California in 1997.



Sudu Chalan

Off the job, Sudu produced a two-week-long Indian Subcontinent cultural program in the Westwood Basic Plus School in 1999 that included presentations, science exhibits, computer demonstrations, dresses, jewelry, music, dance and sports.

The on-the-job Sudu is an 11-year Caltrans employee and Range D Transportation Engineer with a Masters in Civil Engineering (Structures) from the University of California, Irvine. He is an examiner and judge for California Awards for Performance Excellence and California Team Excellence Awards.

Off the job, Sudu produced a two-week-long Indian Subcontinent cultural program in the Westwood Basic Plus School in 1999 that included presentations, science exhibits, computer demonstrations, dresses, jewelry, music, dance and sports. His production also included two live presentations of music and dance by professionals and students of the school. After all that, there was Indian food

Sudu sang solo for Rangoli fine arts at the 40th Annual Los Angeles County Holiday Celebration on December 24th, 1999, at the Dorothy Chandler Pavilion at the Los

Angeles Music Center, broadcast live nationwide. He has performed solo, conducted groups and worked with an array of artists from India and the U.S.

Presently, in his spare time, Sudu, who plays several Western instruments as well, operates a music school with 25 students who range in age from 5 to 50 years of age. The classes are designed on a curriculum with annual examinations, Vijayadashami recitals and lectures, demonstrations and workshops.



Photos by Don Tatum

...It was all part of the kickoff of the 2000 United California State Employees Campaign on September 13, 2000, in Capitol Park.



Caltrans Plays and Sings for United Way

Jande, Dayna Jones, Al Zaid, Frankie Santana, Diana Coleman and Sonia Starks sang solos. Linda, Jerome, and the Caltranets sang together. Vickie Janek and Carlos danced to country music; Mary Ann Lorson and Paul Zimney danced the tango. Frankie Santana told jokes.

It was all part of the kickoff of the 2000 United California State Employees Campaign on September 13, 2000, in Capitol Park.

Cisco Santana-Montez, emcee, kept things going after Linda Buckhammer,



Departmental Campaign Coordinator, kicked off the talent show. Buckhammer introduced Tony Harris, Chief Deputy Director, who shared his own personal experiences with the United Way with attendees; Sherry Hammonds, the Capitol Region UCSEC Director, who also shared personal United Way experiences; and Alice Flissinger, Caltrans' UCSEC Loaned Executive.

All in all, it was quite a success! If you are interested in becoming a UCSEC Steering Committee member and working on activities like those above, contact Linda Buckhammer. As the slogan goes for this year's campaign... "Change the World. Start Here!"

It Takes a Village

Mentor, teacher, counselor, plain all-around-good-guy and, oh yes, representative of District 5 at all kinds of area open houses: that's mechanic Tony Martinez, whose community volunteer work has earned him a good-sized stack of thank-you letters from community leaders and teenagers around San Luis Obispo.

Martinez, who speaks movingly about his youth of picking oranges for peanuts in East Los Angeles, has a knack for connecting with youth, troubled or otherwise. Martinez began representing Caltrans at Career Days at nearby high schools and was so effective that the schools began asking him to speak at school assemblies.

"Not very often does a person come along who is so exceptional that it causes one to stop and take stock of one's own values and ideals. We are fortunate to have such a person among us."



Tony Martinez

Here's what his boss, Dave Higdon, says: "Tony has the exceptional ability to touch at-risk students. Over the past years, Tony has spent time at the Juvenile Court and Community Schools and the Grizzly Challenge program, reaching out to kids in trouble. He shares his own life experiences and stresses the value of staying in school, staying off drugs and out of gangs. Several times, Tony has arranged for kids to come in and see the working of a Caltrans shop firsthand. Kids have stopped by to share their successes with Tony and to thank him for the things he said that helped them on their way.

"Not very often does a person come along who is so exceptional that it causes one to stop and take stock of one's own values and ideals. We are fortunate to have such a person among us."

Snowboarding the Net

Next time someone gives you a hard time about working for a big, heartless State agency, tell them about this:

One Sunday afternoon last winter, John Beischel, a Range D Land Surveyor in Bishop, was headed south toward Ridgecrest on State Route 395. About 90 miles south of Bishop, he flew past a snowboard on the right shoulder of the highway. Beischel made a hurried but safe stop, jumped out and retrieved the snowboard, and put it in the back of his truck.

At Coso Junction just a few miles further on, Beischel took a close look at the snowboard, which was undamaged. He noticed that just behind the rear boot binding was a name scratched in the finish of the board: Yrbacht (name

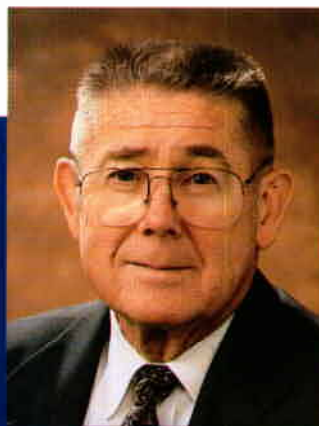


John Beischel

John Beischel proved that the Internet was a useful tool for helping out a citizen. He also proved, once again, that the word "Caltrans" stands for heart as well as excellence.

The next day Beischel's wife called him at work. She had just gotten off the phone with a very happy young man who had described the board down to a gnat's eyebrow. Beischel called the boarder back and arranged for return of the property. A brother would be passing through Bishop in the near future and would stop by to pick it up. "Mr. Yrbacht was lucky his last name wasn't Smith or Jones," says Beischel.

John Beischel proved that the Internet was a useful tool for helping out a citizen. He also proved, once again, that the word "Caltrans" stands for heart as well as excellence.



Jim Roberts

Chief Deputy Jim Roberts has a wall full of awards for his engineering leadership and is in danger of having to obtain a new wall.

changed). Beischel thought it would be nice if he could find the snowboard's owner and return it. The light came on. He decided to go online and use "Switchboard.com" (an online nationwide telephone directory) to see how many Yrbachts were in California. There were 70.

Beischel printed the list, then crossed off all Yrbachts in central and northern California on a hunch that the board belonged to someone south of him. There were still 40 Yrbachts.

Armed with a list of phone numbers, Beischel began calling each, identifying himself and asking if they or anyone in their family were a skier or snowboarder. If he got a yes answer, he asked if they had recently lost any equipment. This went on for some time with no luck. Often he left a message and phone number on an answering machine. Finally, it got so late he stopped calling for the night.

Roberts Cited for Service

Chief Deputy Jim Roberts has a wall full of awards for his engineering leadership and is in danger of having to obtain a new wall for the awards that continue coming his way. Among them:

The American Society of Civil Engineers recently named Roberts the recipient of the 2000 Charles Martin Duke Lifeline Earthquake Engineering Award, "for his technical and public policy-making leadership in the seismic strengthening of bridges and pioneering efforts in earthquake resistant design and retrofit of highway transportation systems."

And the San Francisco Bay Area's Metropolitan Transportation Commission has just selected Roberts to receive the Greta Ericson Distinguished Service Award for his "career of public service to his profession and the citizens of California."



New Tech Awards

So far in 2000, Caltrans has awarded almost \$200,000 in Superior Accomplishment Awards to 592 recipients. The New Technology and Research Program held its awards ceremony on September 7, awarding a Silver Superior Accomplishment Award to Asfand Yar Siddiqui for developing a system to measure vertical



The new Technology Program shows its gratitude and pride for a fistful of accomplishments.

clearances of structures from a vehicle traveling at freeway speeds, eliminating the need for costly and unsafe manual measurements.

Vicki Cobb, William Tournay and Elaine Houmani earned Team Silver Superior Accomplishment Awards for an array of advanced traveler information initiatives, including the Yosemite Area Traveler Information Project, San Francisco Bay Area's TravInfo, TransCal, serving the I-80/US-50 corridor from San Francisco to Reno and Lake Tahoe, and Orange County's TravelTip. These systems provide timely transit, traffic and other transportation information to users of the transportation system.

Others who earned Sustained Superior Accomplishment Awards were: Dawn Barnard-Dingman, for assisting development of a data-based Project Control System to store information concerning the status of over 150

research contracts; Mary Rodriguez, for exemplary support in personnel and resource management; and Mary Jaschke, for a variety of assignments.

Sustained Superior Accomplishment Awards also went to Joe Holland, who supervised a partnered ground-motion research program in Southern California, a partnered guardrail end-terminal project and a quick-change signpost system; and Cliff Roblee, a dedicated professional whose success in developing partnered research recently earned him a National Science Foundation trip to evaluate earthquakes in Turkey and Taiwan.



A Trip to the Top

It is the duty of every new director to make a trip up the cable to the top of the Bay Bridge, kind of like the new ranch owner having to rope that first steer. Pictured above, Caltrans Director Jeff Morales gets the bird's-eye view of San Francisco from the west tower of the department's big workhorse, the San Francisco-Oakland Bay Bridge. Pointing out the sights is District 4's Dennis Mulligan, currently managing the bridge's East Span Replacement project.



Governor Gray Davis has given 13 Safety Awards to Caltrans for key life-saving actions.

Safety Awards

Caltrans picked up 13 Governor's Safety Awards in 2000 for individual and group actions or programs that have safeguarded the lives or health of Caltrans workers or California citizens.

The award program is an annual event designed to recognize outstanding performance of individual State employees and groups for improving job health and safety, responding to life-threatening situations and preventing and reducing occupational injuries and vehicle accidents.

Group awards were given to:

Idlewild Marker Removal System Team, District 1 -
James Jensen, Thomas Palazzi and David Swallow

Wing Plow Committee, District 2 -
Eddie Cahill, Michael Cox, Edward Giroux, Jeff Kiser, John Nelson, Gary Ragan, Micky Riley, Russell Schulz, Allen Thompson and Mark Zumkehr

Toll Collection Safety Team, District 4 -
Roger Bishop, Richard Schatzman, Bruce Yingling

Motorist Assistance, District 5 -
Robert Brown, Robert MacKenzie and Stacy Meacham

Street Smart For Kids, District 8 -
Jeanne Garcia, Dennis Green and Mario Maala

Motorist Assistance, District 10 -
Matthew Brewer, Jon Contreras and David Miller

Individual awards were given to:

John Falco, Equipment Service Center -
Aid to a school bus in danger of bursting into flames

David Matchke, District 3 -
A career of safety accomplishments

Joel Johnson, District 4 -
Training program on the Personnel Hoist

Nicholas Dumas, District 6 -
Community training program on the dangers of highway-rail intersections

John Ortiz, District 7 -
Community training programs on work zone safety

Robert Paris, District 9 -
Inspection program for propane storage safety

Daniel Juarez, District 11 -
Safety inspection checklist form

Editor's Notebook

*A*s I was preparing the story about Route 395, Caltrans' newest Scenic Highway to be found elsewhere in the pages of this journal, I had the pleasure of meeting "Buddy" Bayer, a Caltrans Maintenance Supervisor in Lee Vining. Buddy will have retired, after a career spent working on his beloved Route 395, by the time this journal is printed. Not only did he work on the road as a Caltrans employee, before that, he was an employee of the construction firm that built 395's long climb up the Conway Grade.

Buddy showed me and Don Tateishi, the photographer, a healthy measure of hospitality and even gave us each a copy of a book about Mono County, written by his mother. Just about anything you wanted to know about Mono County, Buddy could tell you about it. And Buddy knew the locations of every pothole, slipout and crack in Route 395's pavement.

As I drove down the highway to my next assignment, I couldn't help thinking, not only about Buddy, but our cadre of Maintenance Supervisors and Superintendents. I've known several of them well as I've bounced around Caltrans, and have been introduced to a lot more. These folks resemble nothing so much as sergeants and master sergeants in the U.S. Army. One of their unofficial duties, by the way, is to educate the fresh-faced novices that Headquarters sends out to supervise them every few years in the realities of keeping a road together.

Most of them are pretty gruff. You can read the years of hard work in punishing weather on most of their faces. Usually they don't look as if they've taken the Surgeon General's latest lifestyle advice very seriously. They eye a

flatlander from Headquarters in Bruno Magli loafers with some humor and not a little suspicion. They're knowledgeable about their roads and their territories, but they're something more. They're savvy. You want to get something done, go talk to a Maintenance Supe. They know the system, and better, they know what part of it works and what doesn't. And they have a knack of using the part that works and going around what doesn't. And if they have to, they'll take up a shovel and work right along with their troops.

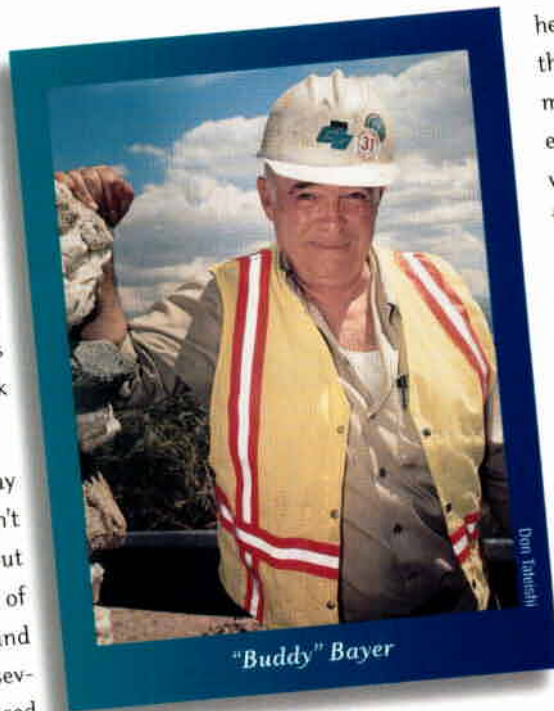
Many of them are bona fide heroes, actually having risked their lives to save those of motorists or their fellow workers. They're in a constant battle with Mother Nature and with forces that seek to take their roads apart, and for the most part they win. And when something really big comes along, like that mess in Walker Canyon a few years back, they take it personally and don't rest until matters are made right again.

The folks in District 9 like to call Buddy Bayer "The Buddha." I confess I kind of like that. A name like that speaks of wisdom, compassion, enlight-

enment and humor. Not bad qualities for a supervisor anyplace in Caltrans.

We thank Buddy for his many years of service and wish him well in retirement.

And we thank our maintenance supervisors and those who work for them for a job well done, often under arduous circumstances.





Gray Davis
Governor of California

Maria Contreras-Sweet
Secretary of the Business,
Transportation and Housing Agency

Jeff Morales
Director of the California
Department of Transportation (Caltrans)